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Mote ‖ Mothe.

a pale reddiſh white ſtreak: the under parts, as far as the breaſt, are of this laſt colour; the reſt more inclined to brown, croſſed with brown lines: the legs are pale brown. It generally carries the tail erect. The neſt is of a curious conſtruction, in ſhape almoſt oval, and has only one ſmall entrance: it is chiefly compoſed of moſs, well lined with feathers. In this the female lays from 10 to 16 or even 18 eggs, which are almoſt white, with reddiſh markings at the large end. She builds twice in a year, in April and June. The neſt is frequently found in ſome corner of an outhouſe, ſtack of wood, hole in a wall, or ſuch like, if near habitations; but in the woods often in a buſh near the ground, in a ſtump of a tree, or on the ground itſelf. This minute bird is found throughout Europe; and in England it defies our ſevereſt winters. Its ſong is much eſteemed, being, though ſhort, a pleaſing warble, and much louder than could be expected from the ſize of the bird: it continues throughout the year.

Above 150 other ſpecies, beſides varieties, are enumerated by ornithologiſts.

MOTE, in law-books, ſignifies court or convention; as a ward-mote, burgh-mote, ſwain-mote, &c.

MOTE, was alſo uſed for a fortreſs or caſtle; as *mota de Windſor*, &c.

MOTE alſo denoted a ſtanding water to keep fiſh in; and ſometimes a large ditch encompaſſing a caſtle or dwelling-houſe.

MOTE-Bell, or *Mot-Bell*, the bell ſo called, which was uſed by the Engliſh Saxons to call people together to the court. See FOLKMOTE.

MOTH, in zoology. See PHALÆNA.

MOTHE LE VAYER (Francis de la), counſellor of ſtate, and preceptor to the duke of Anjou only brother to Louis XIV. was born at Paris in the year 1588. He was well educated by a learned father, whoſe merits and employment rendered him of conſequence; and he became ſo eminently learned himſelf, and diſtinguiſhed by his writings, that he was conſidered as one of the beſt members of the French academy, into which he was admitted in the year 1639. He was loved and conſidered by the two cardinals Richelieu and Mazarine, who governed France ſucceſſively. Splendid titles and honourable poſts were beſtowed upon him. He was appointed preceptor to the duke of Anjou, as we have ſaid, and would have been preceptor alſo to the king his brother, if the queen had not taken a particular fancy not to have that place beſtowed on a married man: though Moreri in his Dictionary, and Peliſſon in his Hiſtory of the French Academy, both affirm that he was preceptor to his majeſty for the ſpace of one year. He was a man of a very regular conduct, and a true philoſopher in his manners; yet was ſuſpected of having no religion. As great a philoſopher as he was, however, he was extremely afflicted at the loſs of his only ſon, who died when about 35 years of age; and his grief diſordered him ſo much that in three months after he married again, although he was above 75 years old. Le Vayer lived a long time after his ſecond marriage, and died in the year 1672. His works, collected into a body by his ſon, were dedicated to cardinal Mazarine in 1653: but the beſt and completeſt collection of them was that of Paris 1669, dedicated to Louis XIV. and conſiſting of 15 volumes in 12mo.

"There is no ſmall advantage (ſays Bayle) to be made of reading this writer: and we have no French author that approaches nearer to Plutarch than he. We find beautiful thoughts and ſolid arguments interwoven and diſperſed through all he wrote; wit and learning go hand in hand. His treatiſe concerning the education of the dauphin, and that of pagan philoſophy, are the beſt which he hath written."

Mother, Motion.

MOTHER, a term of relation, denoting a woman who hath born a child.

MOTHER of Pearl. See MYTILUS.

1 Motion,

MOTION is now generally conſidered as incapable of definition, being a ſimple idea or notion received by the ſenſes. The ancients, however, thought differently. Some of them defined it to be a paſſage out of one *ſtate* into another; which conveys no idea to him who is ignorant of the nature of motion.—The peripatetic definition has been mentioned elſewhere, and ſhown to be wholly unintelligible, as well as their celebrated diviſion of motion into four claſſes, belonging to the three categories, *quality*, *quantity*, and *where*; (ſee METAPHYSICS, n° 188, 189, 190.) The Carteſians, too, among the moderns, pretend to define motion, by calling it a paſſage or removal of one part of matter, out of the neighbourhood of thoſe parts to which it is immediately contiguous, into the neighbourhood of others. Borelli defines motion to be the ſucceſſive paſſage of a body from place to place. Others ſay that it is the application of a body to different parts of infinite and immoveable ſpace; and a late writer * of uncommon acuteneſs has given as a definition of motion—*change of place*.

2 Several definitions of.

* See *An Eſſay on the Powers and Mechaniſm of Nature*, by Robert Young.

We have elſewhere offered our opinion of every poſſible attempt to define motion; but as the author of the laſt quoted definition has endeavoured to obviate ſuch objections as ours, candour requires that he be heard for himſelf. "It is ſaid (he obſerves) by ſome, that change implies motion, and therefore cannot be a part of its definition, being the very thing defined. To this I anſwer, We are ſpeaking of the ſenſible idea of motion, as it appears to our ſight; now changes do appear to our view, and to all our ſenſes, which give us no idea of motion. Changes in heat or cold; in colour, flavour, ſmell, ſound, hardneſs, ſoftneſs, pain, pleaſure; in theſe, and many other ideas, changes do not produce ideas like that produced by a ball rolling or a ſtone falling. We may, perhaps, ultimately trace them to motion, but to inſenſible motions; to motions which ariſe only in reflection, and conſtitute no part of the actual idea of change. We can, therefore, conceive of change, without conceiving at the ſame time of motion.—Change is a generic idea, including many ſpecies; motion, as a ſenſible idea, is a ſpecies of that genus. Change is therefore a neceſſary part of the definition of motion; it marks the genus of the thing defined. Motion is a change; but as there are many ſpecies of change, which of thoſe ſpecies is motion? The anſwer is, It is a change of place. This marks the ſpecies; and diſtinguiſhes it from change of colour, of temperament, and figure."

This is the ableſt defence of an attempt to define motion that we have ever ſeen; and at firſt view the definition itſelf appears to be perfect. Ariſtotle, the prince of definers, "conſiders a definition ‡ as a

‡ See Dr Reid's account of Ariſtotle's logic, in Lord Kames's *Sketches of Man*.

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Motion.

ſpeech declaring what a thing is. Every thing eſſential to the thing defined, and nothing more, muſt be contained in the definition. Now the eſſence of a thing conſiſts of theſe two parts: firſt, what is *common* to it with other things of the ſame kind; and ſecondly, what *diſtinguiſhes* it from other things of the ſame kind. The firſt is called the *genus* of the thing; the ſecond, its *ſpecific difference*. The definition, therefore, conſiſts of thoſe two parts."

3. Shown not to declare what the thing is; and therefore to be no definition.

In obedience to this rule, the definition under conſideration ſeems to conſiſt of the *genus*, ſignified by the word *change;* and of the *ſpecific difference*, denoted by the words *of place*. But does the ſpeech *change of place* really declare what motion is? We cannot admit that it does; as, in our apprehenſion, a *change of place* is the *effect* of motion, and not *motion itſelf*. Suppoſe a lover of dialectic undertaking to define the ſtroke by which he ſaw his neighbour wounded with a bludgeon; what ſhould we think of his art were he to call it a contuſion on the head? He might ſay that *contuſion* is a general term, as contuſions may be produced on the arms, on the legs, and on various parts of the body; and as there are many ſpecies of contuſion, if he were aſked which of thoſe ſpecies was the ſtroke to be defined, he might anſwer, "a contuſion on the head." Here would be apparently the *genus* and *ſpecific difference;* the former denoted by *contuſion*, and the latter by the words *on the head*. But would this be a definition of a ſtroke? No, ſurely: a contuſion on the head may be the *effect* of a ſtroke; but it can no more be the *ſtroke itſelf*, than a blow can be a bludgeon, or a fleſh-wound the point of a ſword. Equally evident it is, that a change of place cannot be motion; becauſe every body muſt have been actually moved before we can diſcern, or even conceive, a change of its place.

The *act of changing place* would perhaps come nearer to a definition of motion; but ſo far would it be from "a ſpeech declaring what motion is," that we are confident a man who had never by any of his ſenſes perceived a body in actual motion, would acquire no ideas whatever from the words "act of changing place." He might have experienced changes in heat, cold, ſmell, and ſound; but he could not poſſibly combine the ideas of ſuch changes with the ſignification of the word *place*, were he even capable of underſtanding that word, which to us appears to be more than doubtful. (See METAPHYSICS, n° 40, 41.)

4. The diſtinctions of motion into different kinds inſignificant.

The diſtinctions of motion into different kinds have been no leſs various, and no leſs inſignificant, than the ſeveral definitions of it. The moderns who reject the peripatetic diviſion of motion into four claſſes, yet conſider it themſelves as either *abſolute* or *relative*. Thus we are told, that "*abſolute motion* is the change of abſolute *place*, and that its celerity muſt be meaſured by the quantity of *abſolute ſpace* which the moving body runs through in a given time." "*Relative motion*, on the other hand, is a mutation of the *relative* or *vulgar place* of the moving body, and has its celerity eſtimated by the quantity of *relative ſpace* run through."

Now it is obvious, that this diſtinction conveys no ideas without a farther explanation of the terms by which it is expreſſed; but that explanation is impoſſible to be given. Thus, before we can underſtand what *abſolute motion* is, we muſt underſtand what is meant by *abſolute place*. But abſolute place is a contradiction; for all *place* is *relative*, and conſiſts in the poſitions of different bodies with regard to one another. Were a globe in the regions of empty ſpace to be put in motion by Almighty Power, and all the reſt of the corporeal world to be ſoon afterwards annihilated, the motion would undoubtedly continue unchanged; and yet, according to this diſtinction, it would be at firſt *relative*, and afterwards *abſolute*. That the beginning of ſuch a motion would be *perceptible*, and the remainder of it *imperceptible*, is readily granted; but on this account to conſider it as of two kinds, is as abſurd as to ſuppoſe the motion of the minute-hand of a clock to be affected by our looking at it.

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5. The opinions of the Carteſians and of Newton reſpecting the ſource of motion.

Leaving therefore theſe unintelligible diſtinctions, we now come to conſider a queſtion ſtill of a very abſtruſe nature, but much agitated among philoſophers, viz. What is the original ſource of motion in the creation? Is it natural to matter? or are we to aſcribe it to the immediate and continual agency of ſome *immaterial* being? The former has been ſtrenuouſly argued by the Carteſians, and the latter by the Newtonians. The arguments of the former, founded upon the chimerical hypotheſis of vortices and the original conſtruction of matter, were evidently inconcluſive; and the hypotheſis of Sir Iſaac Newton, who aſſerted that it was naturally *incapable* of motion, appeared more probable. To account for the quantity of motion in the univerſe, therefore, it became neceſſary to have recourſe either to the Deity, or to ſome ſubordinate ſpiritual agent; and this became the more neceſſary, as the doctrine of an abſolute vacuum in the celeſtial ſpaces, that is, throughout the incomparably greateſt part of the creation, was one of the fundamental maxims of the ſyſtem. As it was abſolutely denied that matter exiſted in theſe ſpaces, and it was plain that the celeſtial bodies affected one another at immenſe diſtances, the powers of attraction and repulſion were naturally called in as the ſources of motion by their impulſe upon inert and ſluggiſh matter. Theſe being admitted, a ſpeculation enſued concerning their nature. *Spiritual*, it was confeſſed, they were; but whether they were to be accounted the immediate action of the divine Spirit himſelf, or that of ſome ſubordinate and inferior ſpirit, was a matter of no little diſpute. Sir Iſaac Newton, towards the latter part of his life, began to relax ſomewhat of the rigidity of his former doctrine; and allowed that a very ſubtile medium, which he called *æther*, might be the cauſe of attraction and repulſion, and thus of the whole phenomena of nature. Since his time the multitude of diſcoveries in electricity, the ſimilarity of that fluid to fire and light, with the vaſt influence it has on every part of the creation with which we are acquainted, have rendered it very probable that the æther mentioned by Sir Iſaac is no other than the element of fire, "the moſt ſubtile † and elaſtic of all bodies, which ſeems to pervade and expand itſelf throughout the whole univerſe. Electrical experiments ſhow that this mighty agent is everywhere preſent, ready to break forth into action if not reſtrained and governed with the greateſt wiſdom. Being always reſtleſs and in motion, it actuates and enlivens the whole viſible maſs; is equally fitted to produce and to deſtroy; diſtinguiſhes the various ſtages of nature, and keeps up the perpetual round of generations and corruptions, pregnant with forms which it

6. A ſubtle æther the probable cauſe of attraction and repulſion.

† *Siris*, n° 153, &c.

Motion. it conſtantly ſends forth and reſorbs. So quick in its motions, ſo ſubtile and penetrating in its nature, ſo extenſive in its effects, it ſeemeth no other than the vegetative ſoul or vital ſpirit of the world.

7 The opinions of the ancients on this ſubject. "The animal ſpirit in man is the inſtrument both of ſenſe and motion. To ſuppoſe ſenſe in the corporeal world would be groſs and unwarranted; but locomotive faculties are evident in all its parts. The Pythagoreans, Platoniſts, and Stoics, held the world to be an animal; though ſome of them have choſen to conſider it as a vegetable. However, the phenomena do plainly ſhow, that there is a ſpirit that moves, and a mind or providence that preſides. This providence, Plutarch ſaith, was thought to be in regard to the world what the ſoul is in regard to man. The order and courſe of things, and the experiments we daily make, ſhow that there is a mind which governs and actuates this mundane ſyſtem as the proper and real agent and cauſe; and that the inferior inſtrumental cauſe is pure æther, fire, or the ſubſtance of light, which is applied and determined by an infinite mind in the macrocoſm or univerſe, with unlimited power, and according to ſtated rules, as it is in the microcoſm with limited power and ſkill by the human mind. We have no proof either from experiment or reaſon of any other agent or efficient cauſe than the mind or ſpirit. When, therefore, we ſpeak of corporeal agents, or corporeal cauſes, this is to be underſtood in a different, ſubordinate, and improper ſenſe; and ſuch an agent we know light or elementary fire to be."

8 Experiments proving that a ſubtle æther may be the immediate cauſe of the planetary motions, &c. That this elementary fire, abſorbed and fixed in all bodies, *may* be the cauſe of the univerſal principle of gravity, is made ſufficiently evident by numberleſs experiments. Homberg having calcined in the focus of a burning-glaſs ſome regulus of antimony, found that it had gained one-tenth in weight, though the regulus, during the whole time of the operation, ſent up a thick ſmoke, and thereby loſt a conſiderable part of its own ſubſtance. It is vain to allege that any heterogeneous matter floating in the air, or that the air itſelf, may have been hurried into the maſs by the action of the fire, and that by this additional matter the weight was increaſed: for it is known experimentally, that if a quantity of metal be even hermetically ſecured within a veſſel of glaſs to keep off the air and all foreign matter, and the veſſel be placed for ſome time in a ſtrong fire, it will exhibit the ſame effect. "I have ſeen the operation performed (ſays Mr Jones†) on two ounces of pewter-filings, hermetically ſealed up in a Florence flaſk, which in two hours gained 55 grains, that is nearly one 17th. Had it remained longer in the fire, it might probably have gained ſomething more; as, in one of Mr Boyle's experiments, ſteel-filings were found to have gained a fourth.

† *Eſſay on the Firſt Principles of Natural Philoſophy.*

"Of accounting for theſe effects there are but two poſſible ways: 1. If the quantity of matter be the ſame, or, in the caſe of calcination, be ſomewhat leſs, after being expoſed to the action of the fire, while the gravity of the whole is become greater; then does it follow, that gravity is not according to the quantity of matter, and of courſe is not one of its properties. 2. If there be an increaſe of the maſs, it can be imputed to nothing but the matter of light or fire entangled in its paſſage through the ſubſtance, and ſo fixed in its pores, or combined with its ſolid parts, as to gravitate together with it. Yet it is certain, from the phenomenon of light darting from the ſun, that this elementary fire does not gravitate till it is fixed in metal, or ſome other ſolid ſubſtance.—Here then we have a fluid which gravitates, if it gravitate at all, in ſome caſes and not in others. So that which way ſoever the experiment be interpreted, we are forced to conclude that elementary or ſolar fire may be the cauſe of the law of gravitation." Motion.

That it is likewiſe in many caſes the cauſe of repulſion, is known to every one who has ſeen it fuſe metals, and convert water and mercury into elaſtic vapour. But there is a fact recorded by Mr Jones, which ſeems to evince that the ſame fluid, which as it iſſues from the ſun exhibits itſelf in the form of light and heat, is in other circumſtances converted into a very fine air, or cold æther, which ruſhes very forcibly towards the body of that luminary. "As a ſequel to what has been obſerved (ſays he) concerning the impregnation of ſolid ſubſtances with the particles of fire, give me leave to ſubjoin an experiment of M. de Stair. He tells us, that upon heating red lead in a glaſs, whence the air was exhauſted by the rays of the ſun collected in a burning-glaſs, the veſſel in which the ſaid red lead was contained burſt in pieces with a great noiſe. Now, as all exploſions in general muſt be aſcribed either to an admiſſion of the air into a rarefied ſpace, or to what is called the *generation* of it; and as air was not admited upon this occaſion, it muſt have been generated from the calx within the veſſel; and certainly was ſo, becauſe Dr Hales has made it appear that this ſubſtance, like crude tartar and many others, will yield a conſiderable quantity of *air* in diſtillation. What went into the metal therefore as *fire*, came out of it again as *air*; which in a manner forces upon us concluſions of ineſtimable value in natural philoſophy, and ſuch as may carry us very far into the moſt ſublime part of it."

One of the concluſions which the ingenious author thinks thus forced upon us, is, that the motion of the planets round the ſun, as well as round their own axis, is to be attributed to the continual agency of this fluid, under its two forms of elementary fire and pure air. As fire and light, we know that it ruſhes with inconceivable rapidity from the body of the ſun, and penetrates every corporeal ſubſtance, exerting itſelf ſometimes with ſuch force as nothing with which we are acquainted is able to reſiſt. If it be indeed a fact, that this elementary fire, or principle of light and heat, afterwards cools, and becomes pure air, there cannot be a doubt, but that under ſuch a form it will return with great force, though ſurely in a ſomewhat different direction, towards the ſun, forming a vortex, in which the planets are included, and by which they muſt of courſe be carried round the centre. Mr Jones does not ſuppoſe that the air into which the principle of light and heat is converted, is of ſo groſs a nature as our atmoſphere. He rather conſiders it as cool æther, juſt as he repreſents light to be æther heated: but he maintains, that this æther, in its aerial form, though not fit for human reſpiration, is a better *pabulum* of fire than the air which we breathe.

This theory is exceedingly plauſible; and the au-

Motion.

thor ſupports it by many experiments. He has not, indeed, convinced us that the ſolar light is converted or convertible into pure air; but he has, by juſt reaſoning from undoubted facts, proved that the whole expanſe of heaven, as far as comets wander, is filled not only with light, which is indeed obvious to the ſenſes, but alſo with a fluid, which, whatever it may be called, ſupplies the place of air in feeding the fire of theſe ignited bodies.

9 The exiſtence of ſuch an æther, however, does not completely ſolve the phenomena.

That the motion of the heavenly bodies ſhould reſult from the perpetual agency of ſuch a medium, appears to us a much more rational hypotheſis, than that which makes them act upon each other at immenſe diſtances through empty ſpace. But the hypotheſis is by no means ſo complete a ſolution of the phænomena as ſome of its fond admirers pretend to think it. This fluid, whether called æther, heat, light, or air, is ſtill material; and the queſtion returns upon him who imagines that it is ſufficient to account for gravitation, repulſion, magnetiſm, and cohefion, &c. "What moves the fluid itſelf, or makes the parts of which it is compoſed cohere together?" However widely it may be extended, it is incapable of poſitive infinity; and therefore *may be* divided into parts ſeparated from each other; ſo that it muſt be held together by a foreign force, as well as a ball of lead, or a piece of wax. As matter is not eſſentially active, the motion of this æther, under both its forms, muſt likewiſe be conſidered as an effect, for which we do not think that any propelling power in the body of the ſun can be admitted as a ſufficient cauſe. For how comes the ſun to poſſeſs that power, and what makes the fluid return to the ſun? We have no notion of power, in the proper ſenſe of the word, but as intelligence and volition; and, by the pious and excellent author of the *Eſſay on the Firſt Principles of Natural Philoſophy*, we are certain that the ſun was never ſuppoſed to be intelligent.

10 It is therefore by ſome ſuppoſed to be animated. ‡ *Siris*, n° 277.

Biſhop Berkeley, who admits of light or æther as the inſtrumental cauſe of all corporeal motion, gets rid of this difficulty, by ſuppoſing, with the ancients, that this powerful agent is animated. "According to the Pythagoreans and Platonics (ſays his Lordſhip‡), there is a life infuſed throughout all things; the πυρ νοερον, πυρ τεχνικον, an intellectual and artificial fire, an inward principle, animal ſpirit, or natural life, producing and forming within, as art doth without; regulating, moderating, and reconciling the various motions, qualities, and parts of this mundane ſyſtem. By virtue of this life, the great maſſes are held together in their ordinary courſes, as well as the minuteſt particles governed in their natural motions, according to the ſeveral laws of attraction, gravity, electricity, magnetiſm, and the reſt. It is this gives inſtincts, teaches the ſpider her web, and the bee her honey. This it is that directs the roots of plants to draw forth juices from the earth, and the leaves and cortical veſſels to ſeparate and attract ſuch particles of air and elementary fire as ſuit their reſpective natures."

This life or animal ſpirit ſeems to be the ſame thing which Cudworth calls plaſtic nature, and which has been conſidered elſewhere. (See METAPHYSICS, n° 200, and *PLASTIC Nature*.) We ſhall therefore diſmiſs it at preſent, with juſt admitting the truth of the Biſhop's poſition, "that if nature be ſuppoſed the life of the world, animated by one ſoul, compacted into one frame, and directed or governed in all its parts by one ſupreme and diſtinct intelligence, this ſyſtem cannot be accuſed of atheiſm, though perhaps it may of miſtake or impropriety."

Motion.

11 A new theory of motion,

A theory of motion ſomewhat ſimilar to that of Berkeley, though in ſeveral reſpects different from it, was not many years ago ſtated with great clearneſs, and ſupported with much ingenuity, in *An Eſſay on the Powers and Mechaniſm of Nature*, intended to improve, and more firmly eſtabliſh, the grand ſuperſtructure of the Newtonian ſyſtem. Mr Young, the author of the eſſay, admits, with moſt other philoſophers of the preſent age, that body is compoſed of atoms which are impenetrable to each other, and may be denominated ſolid. Theſe atoms, however, he does not conſider as primary and ſimple elements, incapable of reſolution into principles; but thinks that they are formed by certain motions of the parts of a ſubſtance immaterial and eſſentially active.

12 By ſuppoſing that a ſubſtance eſſentially active pervades the univerſe.

As this notion is uncommon, and the offspring of a vigorous mind, we ſhall conſider it more attentively under the article *PLASTIC Nature*. It is mentioned at preſent as a neceſſary introduction to the author's theory of motion, of which he attributes both the origin and the continuance to the agency of this elementary ſubſtance pervading the moſt ſolid atoms of the denſeſt bodies. Of every body and every atom he holds the conſtituent principles to be eſſentially active: but thoſe principles act in ſuch a manner as to counterbalance each other; ſo that the atom or body conſidered as a whole is inert, unleſs in ſo far as it reſiſts the compreſſion or ſeparation of its parts. No body or atom can of itſelf begin to move, or continue in motion for a ſingle inſtant: but being pervious to the active ſubſtance, and coaleſcing with it, that ſubſtance, when it enters any body, carries it along with it, till, meeting ſome other body in the way, either the whole of the active ſubſtance lodged in the former body paſſes into the obſtacle, in which caſe the impelling body inſtantly ceaſes to move; or elſe part of that ſubſtance paſſes into the obſtacle, and part remains in the impelling body; and in this caſe both bodies are moved with a velocity in proportion to the quantity of matter which each contains, combined with the quantity of active ſubſtance by which they are reſpectively penetrated.

13 Proofs of the exiſtence of ſuch a ſubſtance.

In order to pave the way for his proof of the exiſtence of one uniform active ſubſtance, he obſerves, that "*change* being an eſſentially conſtituent part of motion, and change implying action, it follows that *all motion implies action, and depends on an active cauſe*. Every motion (he continues) has a beginning, a middle, and an end. The beginning is a change from reſt to motion; the middle is a continuance in motion; the end is a change from motion to reſt." He then proceeds to ſhow, that the beginning of motion is by an action begun; the continuance of motion by an action continued; and the end of motion by a ceſſation of action.

"The firſt of theſe poſitions is admitted by every body. That the *continuance* of motion is by an action *continued*, will be proved, if it ſhall be ſhown that the continuance of a motion is nothing different from its beginning, in regard to any point of time aſſumed in the continued motion. Now the beginning of motion (he ſays) conſiſts in the beginning of change of

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Motion. place. But if any given portions of time and of ſpace are aſſumed, a body beginning to move in the commencement of that time, and in the firſt portion of the ſpace aſſumed, then and there begins that particular motion: and whether before the body began to move in that ſpace it was moving in other ſpaces and times, has no relation to the motion in queſtion; for this being in a ſpace and time altogether diſtinct, is a diſtinct motion from any which might have preceded it immediately, as much as from a motion which preceded it a thouſand years before. It is therefore a new motion begun; and ſo it may be ſaid of every aſſumable point in the continued motion. The term *continued* ſerves only to connect any two diſtinct motions, the end of one with the beginning of the other; but does not deſtroy their diſtinctneſs."

He then proceeds to combat, which he does very ſucceſsfully, the arguments by which the more rigid Newtonians endeavour to prove that a body in motion will continue to be moved by its own *inertia*, till ſtopt by ſome oppoſite force. Having done this, he eſtabliſhes the contrary concluſion by the following ſyllogiſms:

"I. Whatever requires an active force to ſtop its motion, is diſpoſed to move.
Every body in motion requires an active force to ſtop its motion:
Therefore every body in motion is diſpoſed to move.

"II. Whatever is diſpoſed to motion is poſſeſſed of action.
But a body in motion is diſpoſed to continue in motion.
Therefore a body in motion is poſſeſſed of action.

Thus it appears, that the middle part of any motion is action equally with the beginning.

"The laſt part of motion is its *termination*. It is admitted that all motion is terminated by an action contrary to the direction of the motion. It is admitted, too, that the moving body *acts* at the time its motion is deſtroyed. Thus the *beginning* and the *end* of any uniform motion are confeſſed to be actions; but all the intermediate *continuation* which connects the beginning with the end is denied to be action. What can be more unaccountable than this denial? Is it not more conſonant to reaſon and analogy, to aſcribe to the whole continued motion one uninterrupted action? Such a concluſion true philoſophy, we think, requires us to make.

"To move or act, is an attribute which cannot be conceived to exiſt without a ſubſtance. The *action of a body in motion* is indeed the attribute of the body, and the body relatively to its own motion is truly a ſubſtance, having the attribute or quality of motion. But the body being a name ſignifying a combination of certain ideas, which ideas are found to ariſe from action (ſee *Plastic Nature*), that action which is productive of thoſe ideas whoſe combination we denominate body, is of the nature of an attribute. In other terms, body is to be conſidered as an attribute ſo long as it is conſidered as conſtituted of action.—To this attribute we muſt neceſſarily aſſign its ſubſtance. The actions which conſtitute body muſt be actions of ſomething, or there muſt be ſomething which acts. What then is this ACTIVE SOMETHING from whoſe agency we get the idea of body, or whoſe actions conſtitute body? Is it not ſufficient that it is ſomething active? A name might be ſurely given it, but a name would not render the idea more clear. Its deſcription may be found in every ſenſation; it is colour to the eye, flavour to the palate, odour to the noſe, ſound to the ear, and feeling to the touch; for all our ſenſations are but ſo many ways in which this ACTIVE SOMETHING is manifeſted to us. A ſubſtratum of ſolidity philoſophers have imagined to exiſt, and have in vain ſought to find. Our ACTIVE SUBSTANCE is the ſubſtratum ſo long ſought for, and with ſo little ſucceſs. We give it a quality by which it may be perceived; it ACTS. One modification of *action* produces MATTER, another generates MOTION. Theſe modifications of action are modes of the active ſubſtance, whoſe preſence is action: matter and motion conſtitute the whole of nature. THERE IS THEREFORE THROUGHOUT NATURE AN ACTIVE SUBSTANCE, THE CONSTITUENT ESSENCE OF MATTER, AND IMMEDIATE NATURAL AGENT IN ALL EFFECTS." Motion.

14 Which is unintelligent.

By an argument which we do not think very concluſive, our author determines this active ſubſtance to be unintelligent. "In our ſenſations individually, not diſcovering (ſays he) the traces, not ſeeing the characters of intelligence, but finding only action preſent and neceſſary, our inferences go no farther than our obſervations warrant us to do; and we conclude in all theſe things an action only, and that action unintelligent." Having given our opinion of real agency elſewhere (ſee METAPHYSICS, n° 118.), we ſhall not here ſtop to examine this reaſoning.—We may however aſk, Whether all our ſenſations individually be not excited for a *certain end?* If they be, according to our author's mode of arguing in another place, the exciting agent ſhould be an intelligent being. By this we are far from meaning to deny the reality of a ſecondary or inſtrumental cauſe of ſenſation which is deſtitute of intelligence. We are ſtrongly inclined to think that there is ſuch a cauſe, though our perſuaſion reſults not from this argument of our author's. In our opinion, he reaſons better when he ſays, "that a ſubordinate agent conſtructed as the matter of creation, inveſted with perpetual laws, and producing agreeably to thoſe laws all the forms of being, through the varieties of which inferior intelligences can, by progreſſive ſteps, arrive ultimately at the ſupreme contriver, is more agreeable to our ideas of dignity, and tends to impreſs us with more exalted ſentiments, than viewing the Deity directly in all the individual impreſſions we receive, divided in the infinity of particular events, and unawful, by his continual preſence in operations to our view inſignificant and mean."

15 And neither matter nor mind.

This active ſubſtance, or ſecondary cauſe, our author concludes to be neither matter nor mind. "Matter (ſays he) is a being, as a whole quieſcent and inactive, but conſtituted of active parts, which reſiſt ſeparation, or cohere, giving what is uſually denominated ſolidity to the maſs. Mind is a ſubſtance which thinks. A being which ſhould anſwer to neither of theſe definitions, would be neither matter nor mind; but an *immaterial*, and, if I may ſo ſay, an *immental* ſubſtance." Such is the active ſubſtance of Mr Young, which,

Motion. which, conſidered as the cauſe of motion, ſeems not to differ greatly from the *plaſtic nature*, *hylarchical principle*, or *vis genitrix*, of others. The manner in which it operates is indeed much more minutely detailed by our author than by any other philoſopher, ancient or modern, with whoſe writings we have any acquaintance.

" Every thing (he ſays) muſt be in its own nature either diſpoſed to reſt or motion; conſequently the ACTIVE SUBSTANCE muſt be conſidered as a being naturally either quieſcent or motive. But it cannot be naturally quieſcent; for then it could not be active, becauſe activity, which is a tendency to motion, cannot originate in a tendency to reſt. Therefore the ACTIVE SUBSTANCE is by nature motive, that is, tending to motion. The ACTIVE SUBSTANCE is not ſolid, and does not reſiſt penetration. It is therefore incapable of impelling or of ſuſtaining impulſe. Whence it follows, that as it tends to move, and is incapable of having its motion impeded by impulſe, it muſt actually and continually move: in other words, MOTION IS ESSENTIAL TO THE ACTIVE SUBSTANCE.

16 The manner in which it is ſuppoſed to operate,

" In order that this ſubſtance may *act*, ſome other thing upon which it may produce a change is neceſſary; for whatever ſuffers an action, receives ſome change. The active ſubſtance, in acting on ſome other thing, muſt impart and unite itſelf thereto; for its *action* is communicating its *activity*. But it cannot communicate its activity without imparting its ſubſtance; becauſe it is the ſubſtance alone which poſſeſſes activity, and the quality cannot be ſeparated from the ſubſtance. THEREFORE THE ACTIVE SUBSTANCE ACTS BY UNITING ITSELF WITH THE SUBSTANCE ON WHICH IT ACTS. The union of this ſubſtance with bodies, is not to be conceived of as a junction of ſmall parts intimately blended together, and attached at their ſurfaces; but as an entire diffuſion and incorporation of one ſubſtance with another in perfect coaleſcence. As bodies are not naturally active, whenever they become ſo, as they always do in motion, it muſt be by the acceſſion of ſome part of the active ſubſtance. The active ſubſtance being imparted to a body, penetrates the moſt ſolid or reſiſting parts, and does not reſide in the pores without, and at the ſurfaces of the ſolid parts. For the activity is imparted to the body itſelf; and not to its pores, which are no parts of the body: therefore, if the active ſubſtance remained within the pores, the cauſe would not be preſent with its effect; but the cauſe would be in one place and the effect in another, which is impoſſible.

Bodies by their impulſe on others loſe their activity in proportion to the impulſe. This is matter of obſervation. Bodies which ſuffer impulſe acquire activity in proportion to the impulſe. This alſo is matter of obſervation. In impulſe, therefore, the active ſubſtance paſſes out of the impelling body into the body impelled. For ſince bodies in motion are active, and activity conſiſts in the preſence of the active ſubſtance, and by impulſe bodies loſe their activity, therefore they loſe their active ſubſtance, and the loſs is proportional to the impulſe. Bodies impelled acquire activity; therefore acquire active ſubſtance, and the acquiſition is proportioned to the impulſe. But the active ſubſtance loſt by the impelling body ought to be concluded to be that found in the other; becauſe there is no other receptacle than the impelled body to which the ſubſtance parted from can be traced, nor any other ſource than the active body whence that which is found can be derived. Therefore, in impulſe, the active ſubſtance ought to be concluded to paſs from the impelling body to the body impelled. The flowing of ſuch a ſubſtance is a ſufficient cauſe of the communication of activity, and no other rational cauſe can be aſſigned. Motion.

" The continued motion of a body depends not upon its *inertia*, but upon the continuance of the active ſubſtance within the body. The motion of a body is produced by the motion of the active ſubſtance in union with the body. It being evident, that ſince the active ſubſtance itſelf does always move, whatever it is united to will be moved along with it, if no obſtacle prevent. In mere motion, the body moved is the patient, and the active ſubſtance the agent. In impulſe, the body in motion may be conſidered as an agent, as it is made active by its active ſubſtance.—While the active ſubſtance is flowing out of the active body into the obſtacle or impelled body, the active body will preſs or impel the obſtacle. For while the active ſubſtance is yet within the body, although flowing through it, it does not ceaſe to impart to the body its own nature, nor can the body ceaſe to be active, becauſe not yet deprived of the active ſubſtance. Therefore, during its paſſing out of the body, ſuch portion of the active ſubſtance as is yet within, is urging and diſpoſing the body to move, in like manner as if the active ſubſtance were continuing in the body; and the body being thus urged to move, but impeded from moving, preſſes or impels the obſtacle.

17 produce impulſe,

" We ſee here (ſays our author) an obvious explanation of impulſe; it conſiſts in the flowing of the motive ſubſtance from a ſource into a receptacle:" and he thinks, that although the exiſtence of ſuch a ſubſtance had not been eſtabliſhed on any previous grounds, the communication of motion by impulſe does alone afford a ſufficient proof of its reality.

He employs the agency of the ſame ſubſtance to account for many other apparent activities in bodies, ſuch as thoſe of *fire*, *electricity*, *attraction*, *repulſion*, *elaſticity*, &c. All the apparent origins of corporeal activity, ſerve (he ſays) to impart the active ſubſtance to bodies; " and where activity is without any *manifeſt* origin, the active ſubſtance is derived from an inviſible ſource."

Our limits will not permit us to attend him in his ſolution of all the apparent activities in bodies; but the orbicular motions of the planets have been accounted for in ſo many different ways by philoſophers ancient and modern, and each account has been ſo little ſatisfactory to him who can think, and wiſhes to trace effects from adequate cauſes, that we conſider it as our duty to furniſh our readers with the account of this phenomenon which is given by Mr Young.

18 and cauſe the motion of the heavenly bodies.

The queſtion which has been ſo long agitated, " Whence is the origin of motion?" our author conſiders as implying an abſurdity. " It ſuppoſes (ſays he) that reſt was the primitive ſtate of matter, and that motion was produced by a ſubſequent act. But this ſuppoſition muſt ever be rejected, as it is giving precedency to the inferior, and inverting the order of nature." The ſubſtance which he holds to be the baſis

Motion. basis of matter is essentially active; and its action is motion. This motion, however, in the original element, was *power* without direction, agency without order, activity to no end. To this power it was necessary that a LAW should be superadded; that its agency should be guided to some regular purpose, and its motion conspire to the production of some uniform effects." Our author shows, or endeavours to show, by a process of reasoning which shall be examined elsewhere, that the primary atoms of matter are produced by the circular motion of the parts of this substance round a centre; and that a similar motion of a number of these atoms round another centre common to them all, produces what in common language is called a *solid body*; a cannon-ball, for instance, the terrestrial globe, and the body of the sun, &c. In a word, he labours to prove, and with no small success, that a principle of union is implied in the revolving or circulating movements of the active substance.

"But we may also assume (he says) *à priori*, that a principle of union is a general law of nature; because we see in fact all the component parts of the universe are united systems, which successively combine into larger unions, and ultimately form *one* whole." Let us then suppose the sun with all his planets, primary and secondary, to be already formed for the purpose of making one system, and the orbits of all of them, as well as these great bodies themselves, to be pervaded by the active substance, which necessarily exists in a state of motion, and is the cause of the motion of every thing corporeal. "If to this motion a principle of union be added, the effect of such a principle would be a determination of all the parts of the active substance, and of course all the bodies to which it is united, towards a common centre, which would be at rest, and void of any tendency in any direction. But this determination of all the parts of the system towards a common centre, tends to the destruction both of the motion of the active substance and of the system; for should all the parts continually approximate from a circumference towards a centre, the sun and planets would at last meet, and form one solid and quiescent mass. But to preserve existence, and consequently motion, is the first law of the active substance, as of all being; and it cannot be doubted, that to preserve distinct the several parts of the solar system, is the first law given to the substance actuating that system. The union of the system is a subsequent law.

"When the *direct* tendency of any inferior law is obviated by a higher law, the inferior law will operate *indirectly* in the manner the nearest to its direct tendency that the superior law will permit. If a body in motion be obliquely obstructed, it will move on in a direction oblique to its first motion. Now the law of union, which pervades the solar system, being continually obstructed by the law of self-preservation, the motion of the active substance and of the bodies to which it is united can be no other than a revolving motion *about* the common centre of approach, *towards* which all the parts have a determination. But when this revolution has actually taken place, it gives birth to a new tendency, which supersedes the operation of the law of self-preservation. It has been shown, that the motion essential to the active substance, required to be governed by some law to give being to an orderly state of things. Now, there are motions simple and motions complex; the more simple is in all things first in order, and out of the more simple the more complex arises in order posterior. The most simple motion is rectilineal; therefore a rectilineal motion is to be considered as that which is the original and natural state of things, and consequently that to which *all things tend*. It will follow from hence, that when any portion of active substance in which the *law of union* operates, has in the manner above explained been compelled to assume a revolving motion, that is, a motion in some curve; a tendency to a rectilineal motion will continually exist in every part of the revolving portion, and in every point of the curve which it describes during its revolution. And this rectilineal tendency will be a tendency to recede from the centre in every point of the revolving orbit, and to proceed in a tangent to the orbit at each point. These two tendencies, if not originally equal, must necessarily in all cases arrive at an equality. For the tendency towards the centre, called the *centripetal* tendency, that is, the *law of union*, operating first, if we suppose the motion approaches the centre, the tendency to recede from it, called the *centrifugal* tendency, will have its proportion to the centripetal continually increased as the orbit of revolution grows less, so as ultimately to equal the centripetal tendency, and restrain the motion from its central course, at which point it will no longer seek the centre but revolve round it."

As our author holds that every atom of matter is formed by the motion of parts of the active substance, and every body formed by the motion of atoms; so he maintains, not only that the sun, moon, earth, planets, and stars, are penetrated by the same substance, but that each is the centre of a vortex of that substance, and that of these vortices some are included within others. "The subtle revolving fluid, the centre of whose vortex the earth occupies, not only surrounds but pervades the earth, and other vortices their earths, to their centres; and the earth and planets are by its revolutions carried around on their own axes. The earth is an inactive mass, and all its component masses are severally as well as collectively inactive; but the earth and all its parts have various collective and separate movements, imparted from the fluid which surrounds, pervades, and constitutes it. Being immersed together with its proper surrounding sphere or vortex in the larger sphere or vortex of the sun, it is carried thereby in a larger orbit about the sun, at the same time that by the revolution of its proper sphere it rotates on its own axis."

19 Objections to this theory.

Such is the most complete view which our limits will permit us to give of Mr Young's theory of motion. To the philosopher who considers experiment as the only test of truth, and who in all his inquiries employs his hands more than his head, we are fully aware that it will appear in no better light than as "the baseless fabric of a vision." Even to the intellectual philosopher who is not frightened at the word *metaphysics*, we are afraid that such an active substance as the author contends for, will appear as inadequate to the production of the phenomena of gravitation and repulsion as the material æther of Mr Jones and his followers. A being void of intelligence, whether it be material or immaterial, quiescent or motive, cannot

Motion. be the ſubject of law, in the proper ſenſe of the word. The laws of which Mr Young ſpeaks as neceſſary to regulate the motions of the active ſubſtance, muſt be mere *forces*, applied by ſome extrinſic and ſuperior power. And ſince "motion, as it is *eſſential* to the active ſubſtance, is power without direction, agency without order, activity to no end; ſince it is of ſuch a nature, that from its unguided agitations there could reſult neither connection, order, nor harmony;" it follows that thoſe extrinſic forces muſt be *perpetually* applied, becauſe what is *eſſential* to any ſubſtance can never be deſtroyed or changed ſo long as the ſubſtance itſelf remains.

Forces producing order out of confuſion, can be applied only by a being poſſeſſed of intelligence; and if the immediate and perpetual agency of an intelligent being be neceſſary to regulate the motions of the active ſubſtance, that ſubſtance itſelf may be thought ſuperfluous, and its very exiſtence be denied. *Entia non ſunt multiplicanda abſque neceſſitate*, is a rule of philoſophiſing which every man of ſcience acknowledges to be juſt. And it will hardly be denied, that the immediate and perpetual agency of an intelligent being, upon Mr Jones's ætherial fluid, or even upon the matter of ſolid bodies themſelves, would be capable of producing every kind of motion without the inſtrumentality of a ſubſtance which is neither mind nor matter.

Such, we conceive, are the objections which our metaphyſical readers may make to this theory. Part of their force, however, will perhaps be removed by the ingenious manner in which our author analyſes matter into an immaterial principle. But ſo much of it remains, that the writer of this article is inclined to believe that no mechanical account can be given of the motions of the heavenly bodies, the growth of plants, and various other phenomena which are uſually ſolved by attraction and repulſion. In the preſent age, philoſophers in general are ſtrangely averſe from admitting on any occaſion the agency of mind; yet as every effect muſt have a cauſe, it is ſurely not irrational to attribute ſuch effects as mechaniſm cannot produce to the operation either of intelligence or inſtinct. To ſuppoſe the Deity the immediate agent in the great motions of the univerſe, has been deemed impious; and it muſt be confeſſed that very impious concluſions have been deduced from that principle. But there is ſurely no impiety in ſuppoſing, with the excellent biſhop of Cloyne, that the fluid which is known to pervade the ſolar ſyſtem, and to operate with reſiſtleſs force, may be animated by a powerful mind, which acts inſtinctively for ends of which itſelf knows nothing. For the exiſtence of ſuch a mind, no other evidence, indeed, can be brought than what is afforded by a very ancient and very general tradition, and by the impoſſibility of accounting for the phenomena upon principles of mere mechaniſm. Perhaps ſome of our more pious readers may be inclined to think that the Supreme Being has committed the immediate government of the various planetary ſyſtems to powerful *intelligences*, or ANGELS, who, as his miniſters, direct their motions with wiſdom and foreſight. Such an opinion is certainly not abſurd in itſelf; and it ſeems to be countenanced by an ancient writer*, who, though not known by the name of a philoſopher, knew as much of the matter as any founder of the moſt celebrated ſchool.

20 Other theories more ancient and rational.

* *Pſal.* 104.

Motion.

To object to either of theſe hypotheſes, as has been ſometimes done, that it repreſents the government of the world as a perpetual miracle, betrays the groſſeſt ignorance; for we might as well call the movements of the bodies of men and brutes, which are certainly produced by minds, miraculous. We do not affirm that either hypotheſis is certainly true; but they are both as probable and as ſatisfactory as the hypotheſis which attributes agency to attraction and repulſion, to a ſubtle æther, or to a ſubſtance which is neither mind nor matter. Were the immediate agency of intellect to be admitted, there would be no room for many of thoſe diſputes which have been agitated among philoſophers, about the increaſe or diminution of motion in the univerſe; becauſe an intelligent agent, which could begin motion as well as carry it on, might increaſe or diminiſh it as he ſhould judge proper. If inſtinctive agency, or ſomething ſimilar to it, be adopted, there is the ſame room for inveſtigation as upon the principles of mechaniſm; becauſe inſtinct works blindly according to ſteady laws impoſed by a ſuperior mind, which may be diſcovered by obſervation of their effects. As we conſider this as by much the moſt probable hypotheſis of the two, we find ourſelves involved in the following queſtion: "If a certain quantity of motion was originally communicated to the matter of the univerſe, how comes it to paſs that the original quantity ſtill remains?" Conſidering the many oppoſite and contradictory motions which ſince the creation have taken place in the univerſe, and which have undoubtedly deſtroyed a great part of the original quantity, by what means has that quantity been reſtored?

21 The queſtion, Whether the original quantity of motion in the world remains unimpaired? anſwered by

If this queſtion can be ſolved by natural means, it muſt be upon the principles of Newton; for "in every caſe § where quantities and relations of quantities are required, it is the province of mathematics to ſupply the information ſought;" and all philoſophers agree that Sir Iſaac's doctrine of the compoſition and reſolution of motion, though in what reſpects the heavenly bodies it may have no phyſical reality, is ſo mathematically juſt, as to be the only principle from which the quantity of motion, or the force of powers, can in any caſe be computed. If we chooſe to anſwer the queſtion, by ſaying that the motion left is reſtored by the interpoſition of the Deity, then we might as well have had recourſe to him at firſt, and ſay that he alone is the true principle of motion throughout the creation.

§ *Young's Eſſay on the Powers and Mechaniſm, &c.*

Before we are reduced to this dilemma, however, it is neceſſary, in the firſt place, to inquire whether there is or can be any real diminution of the quantity of motion throughout the univerſe? In this queſtion the Carteſians take the negative ſide; and maintain, that the Creator at the beginning impreſſed a certain quantity of motion on bodies, and that under ſuch laws as that no part of it ſhould be loſt, but the ſame portion of motion ſhould be conſtantly preſerved in matter: and hence they conclude, that if any moving body ſtrike on any other body, the former loſes no more of its motion than it communicates to the latter. Sir Iſaac Newton takes the contrary ſide, and argues in the following manner: "From the various compoſitions of two motions, it is manifeſt there is not always

22 The Carteſians, and

23 By Newton

Motion. ways the same quantity of motion in the world; for if two balls, joined together by a slender wire, revolve with an uniform motion about their common centre of gravity, and at the same time that centre be carried uniformly in a right line drawn in the plane of their circular motion, the sum of the motions of the two balls, as often as they are in a right line, drawn from their common centre of gravity, will be greater than the sum of their motions when they are in a line perpendicular to that other. Whence it appears, that motion may be both generated and lost. But, by reason of the tenacity of fluid bodies, and the friction of their parts, with the weakness of the elastic power in solid bodies, nature seems to incline much rather to the destruction than the production of motion; and in reality, motion becomes continually less and less.—For bodies which are either so perfectly hard or so soft as to have no elastic power, will not rebound from each other; their impenetrability will only stop their motion. And if two such bodies equal to one another be carried with equal but opposite motions, so as to meet in a void space, by the laws of motion they must stop in the very place of concourse, lose all their motion, and be at rest for ever, unless they have an elastic power to give them a new motion. If they have elasticity enough to make them rebound with one-fourth, one-half, or three-fourths, of the force they meet with, they will lose three-fourths, one-half, or one-fourth, of their motion. And this is confirmed by experiments: for if two equal pendulums be let fall from equal heights, so as to strike full upon each other; if those pendulums be of lead or soft clay, they will lose all, or almost all, their motion; and if they be of any elastic matter, they will only retain so much motion as they receive from their elastic power."

Motion, therefore, being thus, in the opinion of our celebrated author, *lost*, or *absolutely destroyed*, it is necessary to find some cause by which it may be renewed. Such renovation Sir Isaac attributes to *active* principles; for instance, "the cause of gravity, whereby the planets and comets preserve their motions in their orbits, and all bodies acquire a great degree of motion in falling; and the cause of fermentation, whereby the heart and blood of animals preserve a perpetual warmth and motion, the inner parts of the earth are kept perpetually warmed; many bodies burn and shine, and the sun himself burns and shines, and with his light warms and cheers all things."

Elasticity is another cause of the renovation of motion mentioned by Sir Isaac. "We find but little motion in the world (says he), except what plainly flows either from these active principles, or from the command of the willer."

24 No power of motion ever lost or destroyed,

With regard to the *destruction* or positive *loss* of motion, however, we must observe, that notwithstanding the authority of Sir Isaac Newton, it is altogether impossible that any such thing can happen. All moving bodies which come under the cognizance of our senses are merely passive, and acted upon by something which we call *powers* or *fluids*, and which are to us totally invisible. Motion, therefore, cannot be lost without a destruction or diminution of one of these *powers*, which we have no reason to think can ever happen. When two pendulums rush against each other, the motion is the mere effect of the action of gravity; and that action, which in this case is the *power*, continues to be the very same whether the pendulum moves or moves not. Could motion, therefore, be exhausted in this case, we must suppose, that by separating two pendulums to the same distance from each other, and then letting them come together for a great number of times, they would at last meet with less force than before. But there is certainly not the least foundation for this supposition; and no rational person will take it into his head, that supposing the whole human race had employed themselves in nothing else from the creation to the present day, but separating pendulums and letting them stop each other's motion, they would now come together with less force than they did at first. *Power*, therefore, which is the cause of motion, is absolutely indestructible. Powers may indeed counteract one another, or they may be made to counteract themselves; but the moment that the obstacle is removed, they show themselves in their pristine vigour, without the least symptom of abatement or decay. Motion.

25 proved by Sir Isaac Newton's doctrine of the composition and resolution of motion. Plate CCCXIV.

Under the article MECHANICS, it has been shown, that when motion is compounded of two powers acting obliquely upon one another, more motion is lost than the two powers taken together could spare. Thus, if the two powers AB and AC move a body through the diagonal of the square AD; supposing each of these powers to be $=5$, the diagonal through which they pass will be 7 (A); but from an inspection of the figure, it is manifest, that by the separation of the two powers, a quantity of motion BC, equal to the length of the other diagonal, is lost; for in as far as the two act opposite to each other, they must destroy motion. The quantity of motion produced therefore being 7, and the quantity lost the same, the whole quantity originally existing in the two powers AB and BC ought to have been 14, when it is only 10. To make up for the deficiency, therefore, we must search for the origin of the two powers AB and BC, and this we shall find in the lines A*a*, A*c*, and A*d*; each of which is $3\frac{1}{2}$, altogether making 14; whence deducting 7 the motion lost, we have 7 remaining for the motion produced. Let us now find out the origins of these powers, and we shall find those of A*a* in the lines A*e* and A*f*; the origins of A*c* in A*f* and A*g*. The sources of A*d* we find in the lines A*g* and A*h*. Thus we have now eight sources of the four powers which generated the two first ones; and thus we find that the power AD$=7$, requires two of 5 each $=10$ for its generation; these two require four of $3\frac{1}{2}$ each for their production; and these again require eight of 2.45 each for their production. Hence, in order to generate the two original powers AB and AC, we see that there is required at a very few steps no less than 20; and in like manner, to generate these eight powers, we must have recourse to 16 others; so that the ultimate source of motion increases beyond all calculation.

Whether, therefore, we reckon the ultimate source of motion to be spiritual or material, it is plain that it must be to our conceptions *infinite*; neither will the phe-

(A) It will be something more than 7; but the fractional part is omitted, as being of no importance in the illustration of the fact before us.

Motion. phenomena of nature allow us to give any other explanation than we have done: for no power whatever can loſe more than its own quantity; and it ſeems abſurd to think that the Deity would create the world in ſuch a manner that it would ultimately become immoveable, and then have recourſe to unknown principles to remedy the ſuppoſed defect. On the principle we have juſt now laid down, however, the matter becomes exceedingly plain and obvious. The Creator at firſt formed two oppoſite powers, the action of which is varied according to the circumſtances of the bodies upon which they act; and theſe circumſtances are again varied by the action of the powers themſelves in innumerable ways upon one another, and the approach of one body to another, or their receding to a greater diſtance. Where theſe powers happen to oppoſe each other directly, the body on which they act is at reſt; when they act obliquely, it moves in the diagonal; or if the force acting upon one ſide is by any means leſſened, the body certainly muſt move towards that ſide, as is evident from the caſe of the atmoſphere, the preſſure of which, when removed from one ſide of a body, will make it move very violently towards that ſide; and if we could continually keep off the preſſure in this manner, the motion would aſſuredly be *perpetual*. We muſt not imagine that motion is *deſtroyed* becauſe it is *counteracted*; for it is impoſſible to deſtroy motion by any means but removing the cauſe; counteracting the effect is only a temporary obſtacle, and muſt ceaſe whenever the obſtacle is removed. Nature, therefore, having in itſelf an *infinite* quantity of motion, produces greater or leſſer motions, according to the various action of the moving powers upon different bodies or upon one another, without a poſſibility of the general ſtock being either augmented or diminiſhed, unleſs one of the moving powers was to be withdrawn by the Creator; in which caſe, the other would deſtroy the whole ſyſtem in an inſtant. As to the nature of theſe great original powers, we muſt confeſs ourſelves totally ignorant; nor do we perceive any data from which the nature of them can be inveſtigated. The elements of light, air, &c. are the agents; but in what manner they act, or in what manner they received their action, can be known only to the Creator.

26 The nature of the moving powers unknown.

Perpetual Motion, in mechanics, a motion which is ſupplied and renewed from itſelf, without the intervention of any external cauſe; or it is an uninterrupted communication of the ſame degree of motion from one part of matter to another, in a circle or other curve returning into itſelf, ſo that the ſame momentum ſtill returns undiminiſhed upon the firſt mover.

The celebrated problem of a perpetual motion conſiſts in the inventing a machine, which has the principle of its motion within itſelf. M. de la Hire has demonſtrated the impoſſibility of any ſuch machine, and finds that it amounts to this; *viz.* to find a body which is both heavier and lighter at the ſame time, or to find a body which is heavier than itſelf.

To find a perpetual motion, or to conſtruct an engine, &c. which ſhall have ſuch a motion, is a famous problem that has employed the mathematicians of 2000 years; though none perhaps have proſecuted it with attention and earneſtneſs equal to thoſe of the preſent age.

Infinite are the ſchemes, deſigns, plans, engines, wheels, &c. to which this longed-for perpetual motion has given birth: it were as endleſs as impertinent to give a detail of them all. Motion.

In effect, there ſeems but little in nature to countenance all this aſſiduity and expectation; among all the laws of matter and motion, we know of none yet which ſeems to furniſh any principle or foundation for ſuch an effect.

Animal Motion, that which is performed by animals at the command of the mind or will.

Though all the motions of animals, whether voluntary or involuntary, are performed by means of the muſcles and nerves, yet neither theſe nor the ſubtile fluid which reſides in them are to be accounted the ultimate ſources of animal motion. They depend entirely upon the mind for thoſe motions which are properly to be accounted *animal*. All the involuntary motions, ſuch as thoſe of the blood, the heart, muſcles, organs ſubſervient to reſpiration and digeſtion, &c. are to be claſſed with thoſe of vegetables: for though no vegetables have them in ſuch perfection as animals, there are yet traces of them to be found evidently among vegetables, and that ſo remarkably, that ſome have imagined the animal and vegetable kingdoms to approach each other ſo nearly that they could ſcarce be diſtinguiſhed by a philoſophic eye. See Muscle.

Though the motions of animals, however, depend on the action of the mind or of the will, external objects ſeem originally to have the command of the mind itſelf; for unleſs an animal perceive ſomething, it will not be inclined to act. By means of the ideas once received, indeed, and retained in the memory, it acquires a ſelf-moving power, independent of any object preſent at the time, which is not the caſe with vegetables; for however they may act from a preſent impulſe, their motions never appear to be derived from any ſource which may not be accounted ſtrictly mechanical.

According to ſome, motion is the cauſe of ſenſation itſelf; and indeed it ſeems very probable that the motions of that ſubtle fluid, called *light* or *electricity*, in our bodies always accompany our ſenſations; but whether theſe be the *cauſe*, or only the *medium*, of ſenſe, cannot be diſcovered.

Though all animals are endowed with a power of voluntary motion, yet there is a very great variety in the degrees of that power; to determine which no certain rules can be aſſigned; neither can we, from the ſituation and manner of life of animals, derive any probable reaſon why the motion of one ſhould differ ſo very much from that of another. This difference does not ariſe from their ſize, their ferocity, their timidity, nor any other property that we can imagine. The elephant, though the ſtrongeſt land animal, is by no means the ſloweſt in its motions; the horſe is much ſwifter than the bull, though there is not much difference in their ſize; a gre-hound is much ſwifter than a cat, though the former be much larger, and though both live in the ſame manner, *viz.* by hunting. Among inſects the ſame unaccountable diverſity is obſervable. The louſe and flea are both vermin, are both nearly of the ſame ſize, and both feed on the bodies of animals; yet there is no compariſon between the ſwiftneſs of their motions: while the bug, which is much larger than either, ſeems

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Motion. to have a kind of medium ſwiftneſs between both.—This very remarkable circumſtance ſeems not even to depend on the range which animals are obliged to take in order to procure food for themſelves: the motion of a ſnail is ſlower than that of an earth-worm; while that of many caterpillars is much quicker than either; though we can ſcarce determine which of the three has the greateſt or the leaſt extenſive range for its food.

Of all animals the ſhell-fiſh move the ſloweſt, inſomuch that ſome have ſuppoſed them to be entirely deſtitute of loco-motive powers; and muſcles particularly are denied to have any faculty of this kind. Every one knows that theſe animals can open and ſhut their ſhells at pleaſure; and it cannot eſcape obſervation, that in every muſcle there is a fleſhy protuberance of a much redder colour than the reſt. This has been thought to be a tongue or proboſcis, by which the animal takes in its food; but is in reality the inſtrument of its motion from place to place. This protuberance is divided into two lobes, which perform the office of feet. When the river muſcle is inclined to remove from its ſtation, it opens its ſhell, thruſts out this protuberance, and digs a furrow in the ſand; and into this furrow, by the action of the ſame protuberance, the ſhell is made to fall in a vertical poſition. It is recovered out of this into the former horizontal one, by puſhing back the ſand with the ſame tentacula, lengthens the furrow, and thus the animal continues its journey by a continual turning topſy-turvy.—Marine muſcles perform their motions in the ſame manner, and by ſimilar inſtruments. In general they are firmly attached to rocks or ſmall ſtones by threads about two inches long, which are ſpun from a glutinous ſubſtance in the protuberances already mentioned; theſe are called, in Scotland, the *beards* of muſcles, and are thought to be the cauſe of the fatal diſorders which ſometimes attend the eating of muſcles. See MYTULUS.

Other animals which dwell in bivalved ſhells, perform their motions by a kind of leg or foot; which, however, they can alter into almoſt any figure they pleaſe. By means of this leg they can not only ſink into the mud, or riſe out of it at pleaſure, but can even leap from the place where they are; and this can be done by the limpit, which people are apt to imagine one of the moſt ſluggiſh animals in nature.—When this creature is about to make a ſpring, it ſets its ſhell on edge, as if to diminiſh friction; then, ſtretching out the leg as far as poſſible, it makes it embrace a portion of the ſhell, and by a ſudden movement, ſimilar to that of a ſpring let looſe, it ſtrikes the earth with its leg, and actually leaps to a conſiderable diſtance.

The ſpout, or razor-fiſh, is ſaid to be incapable of moving forward horizontally on the ſurface; but it digs a hole ſometimes two feet deep in the ſand, in which it can aſcend or deſcend at pleaſure. The leg, by which it performs all its movements, is fleſhy, cylindrical, and pretty long; and the animal can at pleaſure make it aſſume the form of a ball. When lying on the ſurface of the ſand, and about to ſink into it, the leg is extended from the inferior end of the ſhell, and makes the extremity of it take on the form of a ſhovel, ſharp on each ſide, and terminating in a point. With this inſtrument the animal makes a hole in the ſand; after which it advances the leg ſtill farther into it, makes it aſſume the form of a hook, and with this, Motion. as a fulcrum, it obliges the ſhell to deſcend into the hole. This operation is continued until the whole ſhell be covered; and when the animal wiſhes to regain the ſurface, it makes the extremity of the leg to aſſume the form of a ball, and makes an effort to extend it. The ball, however, prevents any farther deſcent, and the reaction of the muſcular effort raiſes up the whole ſhell, which operation is continued until it reaches the ſurface; and it is ſurpriſing with what facility theſe motions are accompliſhed by an animal ſeemingly ſo little qualified to move at all. Another particularity in this fiſh is, that though it lives among ſalt water, it abhors ſalt ſo much that when a little is thrown into its hole it inſtantly leaves it. But it is ſtill more remarkable, that if you once take hold of the ſpout fiſh, and then allow it to retire into its hole, it cannot then be driven out by ſalt; though unleſs it be taken hold of by the hand, the application of ſalt will make it come to the ſurface as often as you pleaſe. See SOLEN.

All other ſhell-fiſh, even thoſe apparently the moſt ſluggiſh and deſtitute of any apparatus for motion, are found to be furniſhed with ſuch inſtruments as enable them to perform all thoſe movements for which they have any occaſion. Thus the ſcallop, a well-known animal inhabiting a bivalved ſhell, can both ſwim upon the ſurface of water and move upon land. When it happens to be deſerted by the tide, it opens its ſhell to the full extent, and ſhutting it again with a ſudden jerk, the reaction of the ground gives ſuch an impulſe to the whole, that it ſometimes ſprings five or ſix inches from the ground; and by a continued repetition of this action, it gradually tumbles forward until it regains the water. Its method of ſailing is ſtill more curious. Having attained the ſurface of the water by means unknown to us, it opens the ſhell, and puts one half above water, the other with the body of the animal in it remaining below. Great numbers of them are thus frequently ſeen ſailing in company with their ſhells ſticking up above water when the weather is fine, and the wind acting upon them as ſails; but on the leaſt alarm they inſtantly ſhut their ſhells, and all ſink to the bottom together. See PECTEN.

The oyſter has generally been ſuppoſed one of the moſt ſluggiſh animals in nature, and totally incapable of voluntary motion; but from the reſearches of the Abbé Dicquemarre, this opinion ſeems to be erroneous. The oyſter, like many other bivalved ſhell-fiſh, has a power of ſquirting water out from its body; and this property may eaſily be obſerved by putting ſome of them into a plate with as much ſea-water as will cover them. The water is ejected with ſo much force, as not only to repel the approach of ordinary enemies, but to move the whole animal backwards or ſideways, in a direction contrary to that in which the water was ejected. It has been alſo ſuppoſed, that oyſters are deſtitute of ſenſation; but M. Dicquemarre has ſhown, that they not only poſſeſs ſenſation, but that they are capable of deriving knowledge from experience. When removed from ſuch places as are entirely covered with the ſea, when deſtitute of experience, they open their ſhells and die in a few days; but if they happen to eſcape this danger, and the water covers them again, they will not open their ſhells

Motion. again, but keep them ſhut, as if warned by experience to avoid a danger ſimilar to what they formerly underwent. See OSTREA.

The motions of the ſea-urchin are perhaps more curious and complicated than thoſe of any other animal. It inhabits a beautiful multivalved ſhell, divided into triangular compartments, and covered with great numbers of prickles; from which laſt circumſtance it receives the name of *ſea-urchin* or *ſea hedge-hog*. The triangles are ſeparated from one another by regular belts, and perforated by a great number of holes, from every one of which iſſues a fleſhy horn ſimilar to that of a ſnail, and capable of moving in a ſimilar manner. The principal uſe of theſe horns ſeems to be to fix the animal to rocks or ſtones, though it likewiſe makes uſe of them in its progreſſive motion. By means of theſe horns and prickles, it is enabled to walk either on its back or its belly; but it moſt commonly makes uſe of thoſe which are near the mouth. Occaſionally it has a progreſſive motion by turing round like a wheel. Thus, ſays Mr Smellie ‡, the ſea-urchin furniſhes an example of an animal employing many thouſand limbs in its various movements. The reader may try to conceive the number of muſcles, fibres, and other apparatus which are requiſite to the progreſſive motion of this little animal.

‡ *Phil. of Nat. Hiſt.*

Thoſe animals called *ſea-nettles* or *meduſæ*, though extremely ſlow in their motions, are nevertheleſs evidently capable of moving at pleaſure from place to place. The variety of their figure is ſuch, that it is difficult to aſſign them any determinate figure whatever. In general, however, they reſemble a truncated cone, the baſe of which is applied to the rock to which they adhere. Their colours are various, whitiſh, brown, red, or greeniſh: the mouth is very large; and when opened appears ſurrounded with filaments reſembling the horns of ſnails, which being diſpoſed in three rows around it, give the animal the appearance of a flower*; and through every one of theſe the animal has the power of ſquirting the ſea-water. The ſtructure of theſe animals is extremely ſingular; they conſiſting all of one organ, *viz.* a ſtomach. When ſearching for food, they extend their filaments, and quickly entangle any ſmall animals that come within their reach. The prey is inſtantly ſwallowed, and the mouth ſhut cloſe upon it like a purſe; in which ſtate it remains for many days before the nutritive parts are extracted. The animal, though ſcarcely an inch or an inch and a half in diameter, is neverthes ſo dilatable, that it can ſwallow large whelks and muſcles, the ſhells of which are thrown out by the mouth after the nutritive parts have been exhauſted. Sometimes the ſhell is too large to be voided this way; in which caſe the body of the animal ſplits, and the ſhell is voided through the opening, which in a ſhort time heals up again. The progreſſive motion of this creature is ſo ſlow, that it reſembles that of the hour-hand of a clock, and is performed by means of innumerable muſcles placed on the outſide of the body. All theſe are tubular, and filled with a fluid, which makes them project like prickles. On occaſion it can likewiſe looſen the baſe of the cone from the rock, and inverting its body, move by means of the filaments already mentioned, which ſurround the mouth; but even the motion performed in this manner is almoſt as ſlow as the other.

* See *Aſſinia*.

Some animals are capable of moving backwards, apparently with the ſame facility that they do forwards, and that by means of the ſame inſtruments which move them forward. The common houſe-fly exhibits an inſtance of this, and frequently employs this retrograde motion in its ordinary courſes; though we cannot know the reaſon of its employing ſuch an extraordinary method. Another remarkable inſtance is given by Mr Smellie in the *maſon-bee*. This is one of the ſolitary ſpecies, and has its name from the mode of conſtructing its neſt with mud or mortar. Externally this neſt has no regular appearance, but at firſt ſight is taken for a quantity of dirt adhering to the wall; though the internal part be furniſhed with cells in the ſame regular manner with the neſts of other inſects of the bee-kind. When this bee leaves its neſt, another frequently takes poſſeſſion of it; in which caſe a battle never fails to enſue on the return of the real proprietor. The diſpute is decided in the air; and each party endeavours to get above the other, as birds of prey are wont to do in order to give a downward blow. The undermoſt one, to avoid the ſtroke, inſtead of flying forward or laterally, always flies backward. The encounter is ſo violent, that when they ſtrike, both parties fall to the ground. Motion.

Vegetable MOTION. Though vegetables have not the power of moving from one place to another like animals, they are nevertheleſs capable of moving their different parts in ſuch a manner as would lead us to ſuſpect that they are actuated by a ſort of inſtinct. Hence many have been induced to ſuppoſe, that the animal and vegetable kingdoms are in a manner indiſtinguiſhable from one another; and that the higheſt degree of vegetable life can hardly be known from the loweſt degree of animal life. The eſſential and inſuperable diſtinction, however, between the two, is the faculty of ſenſation, and locomotion in conſequence of it. Were it not, indeed, for the manifeſtation of ſenſe by moving from one place to another, we ſhould not be able to tell whether vegetables were poſſeſſed of ſenſation or not; but whatever motions they may be poſſeſſed of, it is certain that no vegetable has the faculty of moving from one place to another. Some have endeavoured to diſtinguiſh the two kingdoms by the digeſtion of food; alleging that plants have no proper organs, ſuch as a ſtomach, &c. for taking in and digeſting their aliment. But to this it has been replied, that the whole body of a vegetable is a ſtomach, and abſorbs its food at every pore. This, however, ſeems not to be a ſufficient anſwer. All animals take in their food at intervals, and there is not a ſingle inſtance of one which eats perpetually. The food is alſo taken into the body of the animal, and application of the parts made by means of the *internal* organization of the viſcus; but in vegetables, their whole bodies are immerſed in their food, and abſorb it by the ſurface, as animal bodies will ſometimes abſorb liquids when put into them. The roots of a tree indeed will change their direction when they meet with a ſtone, and will turn from barren into fertile ground; but this is evidently mere mechaniſm, without any proof of will or ſenſation; for the nouriſhment of the root comes not from the ſtone, but from the earth around it: and the increaſe in ſize is not owing to any expanſion of the matter which the root already

contains,

Motion. contains, but to the oppoſition of new matter; whence the increaſe of ſize muſt always take place in the direction from whence the nouriſhment proceeds. On this principle alſo may we explain the reaſon why the roots of a tree, after having arrived at the edge of a ditch, inſtead of ſhooting out into the air, will creep down the one ſide, along the bottom, and up the other.

In their other movements the vegetables diſcover nothing like ſenſation or deſign. They will, indeed, uniformly bend towards light, or towards water; but in the one caſe we muſt attribute the phenomenon to the action of the elements of light and air upon them; and in the latter the property ſeems to be the ſame with what in other caſes we call attraction. Thus, if a root be uncovered, and a wet ſponge placed near it in a direction different from that in which the root was proceeding, it will ſoon alter its poſition, and turn towards the ſponge; and thus we may vary the direction of the root as often as we pleaſe. The efforts of a plant to turn from darkneſs or ſhade into ſunſhine are very remarkable; as, in order to accompliſh this, not only the leaves will be inclined, but even the ſtems and branches twiſted. When a wet ſponge is held under the leaves of a tree, they bend down in order to touch it. If a veſſel of water be put within ſix inches of a growing cucumber, in leſs than 24 hours the latter will alter its direction; the branches will bend towards the water, and never alter their courſe until they come in contact with it. The moſt remarkable inſtance of this kind of motion, however, is, that when a pole is brought near a vine, the latter will turn towards it, and never ceaſe extending its branches till it lays hold of the ſupport.

The motions of the ſenſitive plant, and others of the ſame kind, have been conſidered as very wonderful; but it is doubtful if any of them be really more ſo than that of the vine juſt mentioned. None of theſe ſhow any kind of propenſity to move without an actual touch. A very ſlight one, indeed, makes the ſenſitive plant contract, and the whole branch, together with the leaves, bend down towards the earth.—This is ſo ſimilar to ſome phenomena of electricity, that very few will heſitate at aſcribing both to the ſame cauſe. Even the motions of the hedyſarum gyrans, which at firſt ſight ſeem ſo much more ſurpriſing than thoſe of the ſenſitive plant, may be explained upon the ſame principle. There is a ſpecimen of this plant in the botanic garden of Edinburgh. It is a native of the Eaſt Indies, and its motions are occaſioned by the ſun-beams. The leaves are the only moveable parts. They are ſupported by long foot-ſtalks; and when the ſun ſhines upon them they move briſkly in every direction. Their moſt uſual motion is upward and downward; but not unfrequently they turn almoſt quite round, and then the foot-ſtalks are evidently twiſted. Theſe motions continue only while the light and heat of the ſun continues, ceaſing when at night, or when the weather becomes cloudy and cold. The American plant called *Dionæa muſcipula*, or *Venus's fly trap*, is another example of very wonderful mechaniſm in vegetables, though even this does not argue any degree of ſenſation in this plant more than in others. The leaves of the dionæa are jointed, and furniſhed with two rows of prickles. A number of ſmall glands upon the ſurface ſecrete a ſweet juice, which entices flies to come and ſettle upon it; but the moment theſe inſects touch the fatal ſpot, the leaves fold up, and ſqueeze them to death between the prickles. The leaves fold up in the ſame manner when the plant is touched with a ſtraw or pin. Motion.

The folding up of the leaves of certain plants in the abſence of the ſun's light, called their *ſleep*, affords another very curious inſtance of vegetable motion.—Almoſt all vegetables, indeed, undergo ſuch a remarkable change in the night, that it is difficult to know exactly how many kinds do really ſleep. They fold up their leaves in many different ways; but all agree in diſpoſing of them in ſuch a manner as to afford the beſt protection to the young ſtems, flower-buds, or fruit. The leaves of the tamarind-tree contract round the young fruit, in order to protect it from nocturnal cold; and thoſe of ſenna, glycina, and many other papilionaceous plants, diſpoſe of their leaves in the ſame manner. The leaves of the chickweed, aſclepias, atriplex, &c. are diſpoſed in oppoſite pairs. In the night-time they riſe perpendicularly, and join ſo cloſe at the top that the flowers are concealed by them. In like manner do the leaves protect the flowers of the ſida, or althæa theophraſti, the aycnia, and œnothira, the ſolanum, and the Egyptian vetch. All theſe are erected during the night; but thoſe of the white lupine, in time of ſleep, hang down.

The flowers of plants alſo have motions peculiar to themſelves. Many of them during the night are incloſed in their calyxes. Some, particularly thoſe of the German ſpurge, geranium ſtriatum, and common Whitlow-graſs, when aſleep bend towards the earth; by which means the noxious effects of rain or dew are prevented. All theſe motions have been commonly aſcribed to the ſun's rays; and Mr Smellie informs us, that in ſome of the examples above-mentioned the effects were evidently to be aſcribed to heat: but plants kept in an hot-houſe, where the temperature of the day and night are alike, contract their leaves, and ſleep in the ſame manner as if they were expoſed to the open air; "whence it appears (ſays he), that the ſleep of plants is owing rather to a peculiar law, than to a quicker or ſlower motion of the juices." He ſuſpects, therefore, that as the ſleep of plants is not owing to the mere abſence of heat, it may be occaſioned by the want of light; and to aſcertain this he propoſes an experiment of throwing upon them a ſtrong artificial light. "If, notwithſtanding this light (ſays he), the plants are not rouſed, but continue to ſleep as uſual, then it may be preſumed that their organs, like thoſe of animals, are not only irritable, but require the reparation of ſome invigorating influence which they have loſt while awake, by the agitations of the air and of the ſun's rays, by the act of growing, or by ſome other latent cauſe." On this, however, we muſt remark, that the throwing of artificial light upon plants cannot be attended with the ſame conſequences as that of the light of the ſun, unleſs the former were as ſtrong as the latter, which is impoſſible; and even granting that we could procure an artificial light as ſtrong as that of the ſun, a difference might be occaſioned by the different directions of the rays, thoſe of the ſun being very nearly parallel, while the rays of all artificial light diverge very greatly. If, therefore,

we

Motion. we are to make an experiment of this kind, the rays ſhould be rendered parallel by means of a burning mirror. Here again we would be involved in a difficulty: for the rays of the ſun proceed all in one direction; but as of neceſſity we muſt employ different mirrors in our experiment, the light muſt fall upon the plant in different directions, ſo that we could not reaſonably expect the ſame reſult as when the plants are directly expoſed to the rays of the ſun.

The motion of plants, not being deducible from ſenſation, as in animals, muſt be aſcribed to that property called *irritability*; and this property is poſſeſſed *inſenſibly* by the parts of animals in a greater degree than even by the moſt irritable vegetable. The muſcular fibres will contract on the application of any ſtimulating ſubſtance, even after they are detached from the body to which they belonged. The heart of a frog will continue to beat when pricked with a pin for ſeveral hours after it is taken out of the body. The heart of a viper, or of a turtle, beats diſtinctly from 20 to 30 hours after the death of theſe animals. When the inteſtines of a dog, or any other quadruped, are ſuddenly cut into different portions, all of them crawl about like worms, and contract upon the ſlighteſt touch. The heart, inteſtines, and diaphraghm, are the moſt irritable parts of animal bodies; and to diſcover whether this quality reſides in all plants, experiments ſhould be made chiefly on leaves, flowers, buds, and the tender fibres of the roots.

The motions of plants are univerſally aſcribed by our author to *irritability*, to which alſo we have aſcribed them under the article Animal. The term, however, requires an explanation; and to give this in an intelligible manner requires ſome attention. The moſt obvious compariſon is that of an electrified thread; which, on the approach of any unelectrified ſubſtance, ſhows a variety of motions, equally ſurpriſing with thoſe of the parts of plants or the muſcular fibres cut out of the body. Could we ſuppoſe that the electricity of a thread might be preſerved after it was cut off from the electriſying ſubſtance, it would ſhow as much irritability as even the muſcular fibres, or portions of the inteſtines of animals. We know, from the hiſtory of the torpedo, electrical eel, &c. that there are animals in which the electric fluid acts in ſuch a manner as to produce a much more powerful effect than that of giving motion to the leaves of plants. The readineſs, therefore, with which this fluid is thrown into agitations when any ſubſtance in which it acts is touched, is without doubt the irritability in queſtion; but we have from thence no more reaſon to aſcribe ſenſation to theſe irritable bodies, than to an electrified bottle when it diſcharges itſelf, or makes a cork-ball play around it.

In a paper read before the Academy of Sciences at Paris, by M. Brouſſonet, the author inclines to confound irritability and ſenſibility together. "The different parts of plants (ſays he) enjoy the faculty of motion; but the motions of a vegetable are very different in their nature from thoſe of an animal: the moſt ſenſible, thoſe that are produced with moſt rapidity in plants, are always influenced by ſome ſtimulating cauſe. Irritability, which is nothing but *ſenſibility* made manifeſt by motion, is a general law to which nature has ſubjected all living beings; and it is this that continually watches over their preſervation. Being more powerful in animals than in plants, it may be often confounded in theſe laſt with phenomena that depend on a quite different cauſe. In the vegetable it is only the organ which is expoſed to the action of the ſtimulating power that moves. Irritation in particular places never produces that prompt combination of ſenſations which we obſerve in animals; in conſequence of which certain parts are put in motion without being directly affected, and which otherwiſe might have been paſſive. Motion.

"The more perfect the organization in the different parts of animals is, the more apparent are the ſigns of irritability. The parts that come neareſt to thoſe of vegetables, and in which of conſequence the organization is moſt imperfect, are the leaſt irritable. The ſame law holds with regard to plants; but the reſult is oppoſite: the ſigns of irritability are moſt ſenſible in proportion to the analogy of the parts with thoſe of animals; and they are imperceptible in thoſe that are diſſimilar. This aſſertion is proved by what we obſerve in the organs deſtined in vegetables to prepetuate the ſpecies. Thoſe parts alone ſeem ſenſible to ſtimuli; the bark, leaves, ſtalks, and roots ſhowing no ſigns of irritability.

"The vital motions in plants are ſlow, and entirely determined by circumſtances, which are always repeated and equally diffuſed over all the parts. In animals, on the contrary, almoſt all the vital motions are very ſenſible; ſuch as the pulſations of the heart and arteries, the dilatation of the thorax, &c.: theſe being abſolutely neceſſary to the preſervation of the individual, are always reproduced in a ſimilar manner in thoſe of the ſame ſpecies, and in the ſame direction; and this takes place in like manner in plants. The twining plants, for inſtance, ſuch as the hop, follow conſtantly, as they twiſt themſelves round a pole, the direction of the ſouth towards the weſt. If vegetables are obſtructed in exerciſing theſe motions, they ſoon periſh: if, for example, we untwiſt a twining plant which had taken its direction round a branch from the right to the left, and place it in a contrary direction, it withers in a ſhort time; eſpecially if it has not vigour enough to regain its natural ſituation. We bring death in the ſame manner on an animal, if we interrupt any of its vital motions. The law by which plants are forced to move in a particular manner is very powerful: When two twining plants, one of which is weaker than the other, for example two plants of woodbine, happen to encounter, they twiſt round each other, the one directing itſelf to the right and the other to the left: this laſt is always the weakeſt; it is forced to take a direction contrary to that which it would have done if it had not met with the other: but if, by any accident, theſe two twigs of woodbine ſhould come afterwards to be ſeparated, they both reſume their natural direction, that is, from right to left.

"The motions eſſentially vital, which have in plants the greateſt affinity with thoſe of animals, are the courſe of the ſap, the paſſage of the air in the trachea, the different poſitions which the flowers of certain plants take at certain hours of the day, &c. But if we attend to the manner in which all theſe motions in plants are performed, we will find that they preſent a greater

Motion. number of modifications than the analogous motions that take place in animals. The temperature of the atmoſphere, its agitation, light, &c. have great influence on the motions of plants, by accelerating or retarding the courſe of their fluids; and, as they cannot change their place, theſe variations produce in them changes more obvious and more uniform than in animals."

Our author now proceeds to inform us, that ſome of the motions of plants are occaſioned by the rarity of the juices in plants, and others by their abundance. Of the former kind are thoſe by which the capſules of ſome plants ſuddenly burſt with a ſpring, and throw their ſeeds to ſome diſtance. Of the other kind are the action of the ſtamina in the *parietaria*, the inflection of the peduncles of flowers, and of the piſtilla. "Thoſe motions (ſays he) which are particularly obſerved in the organs deſtined to the reproduction of the individual, not appearing except in circumſtances that render them abſolutely neceſſary, ſeem in ſome meaſure to be the effect of a particular combination: they are, however, merely mechanical; for they are always produced in the ſame way and in the ſame circumſtances. Thus the roſe of Jericho, and the dry fruit of ſeveral ſpecies of *meſembryanthemum*, do not open but when their veſſels are full of water.

"The ſudden diſengagement of fluids produces a kind of motion. To this cauſe we muſt attribute a great number of phenomena obſervable in the leaves of ſeveral plants, and which do not depend on irritability. The ſmall glands in each leaf of the *dionæa* are no ſooner punctured by an inſect than it inſtantly folds up and ſeizes the animal: the puncture ſeems to operate a diſengagement of the fluid which kept the leaf expanded by filling its veſſels. This explanation is the more probable, that in the early ſtate of the vegetation of this plant, when the ſmall glands are hardly evolved, and when probably the juices do not run in ſufficient abundance, the leaves are folded up exactly as they appear when punctured by an inſect at a more advanced period. We obſerve a phenomenon ſimilar to this in both ſpecies of the *droſera* (ſundew). The mechaniſm here is very eaſily obſervable: the leaves are at firſt folded up; the juices are not yet propelled into the fine hairs with which they are covered; but after they are expanded, the preſence of the fluid is manifeſt by a drop ſeen at the extremity of each hair: it is by abſorbing this fluid that an inſect empties the veſſels of the leaf, which then folds up, and reſumes its firſt ſtate: the promptitude of the action is proportioned to the number of hairs touched by the inſect. This motion in ſome degree reſembles that which takes place in the limb of an animal kept in a ſtate of flexion by a tumor in the joint; when the matter which obſtructed the motion is diſcharged, the limb inſtantly reſumes its former poſition. The phenomena that depend on the abundance of fluids are particularly evident in plants which grow in wet ſoils; the *droſera* and *dionæa* are of this kind: and it is known by the experiments of Meſſ. Du Fay and Du Hamel, that ſenſitive plants are particularly ſenſible when the ſun is obſcured by clouds and the air warm and moiſt. The influence of external cauſes ſometimes ſo modifies the vital motions in plants, that we would be tempted to aſcribe them to volition, like thoſe that depend entirely on that faculty in animals. If we ſet a pole in the ground near a twining plant, it always lays hold of the pole for ſupport, in whatever place we put it. The ſame thing occurs in the tendrils of the vine; which always attach themſelves to the ſupport preſented them, on whatever ſide it may be placed, provided they can reach it: but theſe motions are entirely vital: the twining plants and the tendrils direct themſelves to every quarter, and conſequently cannot fail of meeting with the bodies within their reach. Theſe motions are performed as long as the parts continue to grow; but when they ceaſe to elongate, if they have not been able to reach any body on which they can fix, they bend back upon themſelves. This and other obſervations ſhow how far the vital motions in plants may be modified by external cauſes, and how eſſentially they differ from thoſe that are the effect of volition in animals. Motion || Motte.

"Some plants appear endowed with no ſort of motion: ſome have leaves that can move in different directions: their motions are generally modified by different cauſes; but none appear ſo eminently poſſeſſed of this quality as the *hedyſarum gyrans* of Linnæus.—No part of this plant ſhows any ſigns of irritability upon application of ſtimuli: and the motion of its foliola ceaſes when the leafets are agitated by the wind.—When the ſun is warm, the little leaves of the hedyſarum are alſo immoveable; but when the weather is warm and moiſt, or when it rains, they move very freely. This motion ſeems indiſpenſably neceſſary to the plant: for it begins as ſoon as the firſt leaves unfold, and continues even during the night; but in time it grows weaker. In our ſtoves it is moſt conſiderable during the firſt year; in the ſecond, it is not very ſenſible: in its native place all the leaves have a motion never obſerved here. The moving leafets are moſt agitated while the plants are in full flower, and the proceſs of fructification goes on. The oſcillatory motion is ſo natural to it, that it not only remains for three or four days in the leafets of a branch that has been cut off and put in water, but is even continued though the branch be expoſed to the air. The leaves ſeem to perform the office of the heart in vegetables. When a plant is ſtripped of its leaves, the progreſs of vegetation is arreſted; and ſuch vegetables reſemble thoſe animals which have a periodical ſleep, induced by a diminution of the action of the heart. Many plants hardly ſhow any ſigns of motion; many ſeem alſo wholly cataleptic; which is rarely if ever found in animals. The footſtalks of the flowers of dracocephalum, a Virginian plant, preſerve themſelves in whatever poſition they are placed.

Muſcular Motion. See Muscle.

MOTIVE, is ſometimes applied to that faculty of the human mind, by which we purſue good and avoid evil. Thus Hobbes diſtinguiſhes the faculties of the mind into two ſorts, the cognitive and motive.

MOTTE (Anthony Houdart de la), an ingenious Frenchman, greatly diſtinguiſhed by his writings in proſe and verſe, and by his literary conteſts with many eminent perſons, was born at Paris in 1672. He wrote with very different ſucceſs, no man having been more praiſed or more criticiſed than he was: his literary paradoxes,

Motualis. radoxes, his ſingular ſyſtems, in all branches of polite learning, and above all his judgment upon the ancients, which, like thoſe of Perrault, were thought diſreſpectful and detracting, raiſed him up formidable adverſaries. Racine, Boileau, Rouſſeau, and Madam Dacier, were among the number of thoſe who made it their buſineſs to avenge antiquity on a man who, with more wit than genius or learning, aſſumed a kind of dictatorial authority in the province of belles lettres. He became blind in the latter years of his life, and died in 1731. He wrote a great deal in epic poetry, tragedy, comedy, lyric, paſtoral, and fables; beſides a vaſt variety of diſcourſes, critical and academical, in proſe. A complete edition of all his works was publiſhed in 11 vols 8vo, in 1754; though, as has been ſaid of our Swift, his reputation had been better conſulted by reducing them to three or four.

MOTOUALIS, a ſmall nation of Syria, inhabiting to the eaſt of the country of the DRUSES, in the valley which ſeparates their mountains from thoſe of Damaſcus; of which the following account is given by Mr Volney in his Travels, vol. ii. p. 84.

The characteriſtic diſtinction between them and the other inhabitants of Syria (ſays our author) is, that they, like the Perſians, are of the ſect of Ali, while all the Turks follow that of Omar or Moaouia. This diſtinction, occaſioned by the ſchiſm which in the 36th year of the Hejira aroſe among the Arabs, reſpecting the ſucceſſors of Mahomet, is the cauſe of an irreconcileable hatred between the two parties. The ſectaries of Omar, who conſider themſelves as the only orthodox, aſſume the title of *Sonnites*, which has that ſignification, and term their adverſaries *Shiites*, that is "ſectaries of Ali." The word *Motouali* has the ſame meaning in the dialect of Syria. The followers of Ali, diſſatisfied with this name, ſubſtitute that of *Adlia*, which means "aſſertors of juſtice," literally "Juſticiarians:" a denomination which they have aſſumed in conſequence of a doctrinal point they advance in oppoſition to the Sonnite faith. A ſmall Arabic treatiſe, entitled Theological Fragments concerning the Sects and Religions of the World, has the following paſſage:

"Thoſe ſectaries who pretend that God acts only on principles of juſtice, conformable to human reaſon, are called *Adlia* or *Juſticiarians*. God cannot (ſay they) command an impracticable worſhip, nor ordain impoſſible actions, nor enjoin men to perform what is beyond their ability; but wherever he requires obedience, will beſtow the power to obey. He removes the cauſe of evil, he allows us to reaſon, and impoſes only what is eaſy, not what is difficult; he makes no man reſponſible for the actions of another, nor puniſhes him for that in which he has no part; he imputes not as a crime what himſelf has created in man; nor does he require him to avoid what deſtiny has decreed. This would be injuſtice and tyranny, of which God is incapable from the perfection of his being." To this doctrine, which diametrically oppoſes the ſyſtem of the Sonnites, the Motoualis add certain ceremonies which increaſe their mutual averſion. They curſe Omar and Moaouia as rebels and uſurpers; and celebrate Ali and Hoſain as ſaints and martyrs. They begin their ablutions at the elbow, inſtead of the end of the finger, as is cuſtomary with the Turks; they think themſelves defiled by the touch of ſtrangers; and, contrary to the general practice of the Eaſt, neither eat nor drink out of a veſſel which has been uſed by a perſon not of their ſect, nor will they even ſit with ſuch at the ſame table. Motoualis.

Theſe doctrines and cuſtoms, by ſeparating the Motoualis from their neighbours, have rendered them a diſtinct ſociety. It is ſaid they have long exiſted as a nation in this country, though their name has never been mentioned by any European writer before the preſent century; it is not even to be found in the maps of Donville: La Roque, who left their country not a hundred years ago, gives them the name of *Ameidens*. Be this as it may, in later times their wars, robberies, ſucceſſes, and various changes of fortune, have rendered them of conſequence in Syria. Till about the middle of this century, they only poſſeſſed Balbek their capital, and a few places in the valley, and Anti-Lebanon, which ſeems to have been their original country. At that period we find them under a like government with the Druzes, that is to ſay, under a number of Shaiks, with one principal chief of the family of Harfouſh. After the year 1750 they eſtabliſhed themſelves among the heights of Bekaa, and got footing in Lebanon, where they obtained lands belonging to the Maronites, almoſt as far as Beſharrai. They even incommoded them ſo much by their ravages, as to oblige the Emir Youſef to attack them with open force and expel them; but on the other ſide, they advanced along the river even to the neighbourhood of Sour, (Tyre). In this ſituation, Shaik Daher had the addreſs, in 1760, to attach them to his party. The pachas of Saide and Damaſcus claimed tributes, which they had neglected paying, and complained of ſeveral robberies committed on their ſubjects by the Motoualis; they were deſirous of chaſtiſing them; but this vengeance was neither certain nor eaſy. Daher interpoſed; and by becoming ſecurity for the tribute; and promiſing to prevent any depredations, acquired allies who were able, as it is ſaid, to arm 10,000 horſemen, all reſolute and formidable troops. Shortly after they took poſſeſſion of Sour, and made this village their principal ſea-port. In 1771 they were of great ſervice to Ali Bey and Daher againſt the Ottomans. But Emir Youſef having in their abſence armed the Druzes, ravaged their country. He was beſieging the caſtle of Djezin, when the Motoualis, returning from Damaſcus, received intelligence of this invaſion. At the relation of the barbarities committed by the Druzes, an advanced corps, of only 500 men, were ſo enraged, that they immediately ruſhed forward againſt the enemy, determined to periſh in taking vengeance. But the ſurpriſe and confuſion they occaſioned, and the diſcord which reigned between the two factions of Manſour and Youſef ſo much favoured this deſperate attack, that the whole army, conſiſting of 25,000 men, was completely overthrown.

In the following year, the affairs of Daher taking a favourable turn, the zeal of the Motoualis cooled towards him, and they finally abandoned him in the cataſtrophe in which he loſt his life. But they have ſuffered for their imprudence under the adminiſtration of the pacha who ſucceeded him. Since the year 1777, Djezzar, maſter of Acre and Saide, has inceſſantly

Motteux || Movement.

ſantly laboured to deſtroy them. His perſecution forced them in 1784 to a reconciliation with the Druſes, and to enter into an alliance with the Emir Youſef. Though reduced to leſs than 700 armed men, they did more in that campaign than 15,000 or 20,000 Druzes and Maronites aſſembled at Dair-el-Kamar. They alone took the ſtrong fortreſs of Mar-Djebaa, and put to the ſword 50 or 60 Epirots who defended it. But the miſunderſtanding which prevailed among the chiefs of the Druzes having rendered abortive all their operations, the pacha has obtained poſſeſſion of the whole valley, and the city of Balbek itſelf. At this period not more than 500 families of the Motoualis remained, who took refuge in Anti-Lebanon, and the Lebanon of the Maronites; and, driven as they now are from their native ſoil, it is probable they will be totally annihilated, and even their very name become extinct.

MOTTEUX (Peter), a French gentleman, born and educated at Rouen in Normandy. Coming over to England on account of the perſecution of the Proteſtants, he became a conſiderable trader in London, kept an Eaſt-India warehouſe in Leadenhall-ſtreet, and had a genteel place in the general poſt-office, relating to foreign letters, being maſter of ſeveral languages. He was a man of wit and humour; and acquired ſo perfect a maſtery of the Engliſh language, that he not only was qualified to oblige the world with a very good tranſlation of Don Quixote, but alſo wrote ſeveral ſongs, prologues, epilogues, &c. and what was ſtill more extraordinary, became a very eminent dramatic writer in a language to which he was not a native. He was at laſt, in the year 1718, found dead in a diſorderly houſe, on his birth-day, when he completed his 58th year.

MOTTO, in armoury, a ſhort ſentence or phraſe, carried in a ſcroll, generally under, but ſometimes over, the arms; ſometimes alluding to the bearing, ſometimes to the name of the bearer, and ſometimes containing whatever pleaſes the fancy of the deviſer.

MOUCHO MORE. See AGARICUS.

MOVEABLE, in general, denotes any thing capable of being moved.

MOVEABLE-Feaſts, are ſuch as are not always held on the ſame day of the year or month; though they be on the ſame day of the week. See FEASTS.

Thus, Eaſter is a moveable feaſt, being always held on the Sunday which falls upon or next after the firſt full moon following the 21ſt of March.

All the other moveable feaſts follow Eaſter, *i.e.* they keep their diſtance from it; ſo that they are fixed with reſpect thereto.

Such are Septuageſima, Sexageſima, Aſh-Wedneſday, Aſcenſion-day, Pentecoſt, Trinity-Sunday, &c. which ſee under their proper articles, SEPTUAGESIMA, &c.

MOVEABLE-Subject, in law, any thing that moves itſelf, or can be moved; in contradiſtinction to immoveable or heritable ſubjects, as lands, houſes, &c.

MOVEMENT, MOTION, a term frequently uſed in the ſame ſenſe with automaton.

The moſt uſual movements for keeping time are watches and clocks: the firſt are ſuch as ſhow the parts of time, and are portable in the pocket; the ſecond, ſuch as publiſh it by ſounds, and are fixed as furniture. See HOROLOGY.

Movement, Mouſet.

MOVEMENT, in its popular uſe among us, ſignifies all the inner work of a watch, clock, or other engine, which move, and by that motion carry on the deſign of the inſtrument.

The movement of a clock or watch is the inſide, or that part which meaſures the time, ſtrikes, &c. excluſive of the frame, caſe, dial-plate, &c.

The parts common to both of theſe movements are, the main-ſpring, with its appurtenances; lying in the ſpring-box, and in the middle thereof lapping about the ſpring-arbor, to which one end of it is faſtened. A-top of the ſpring-arbor is the endleſs-ſcrew and its wheel; but in ſpring-clocks, this is a ratchet-wheel with its click, that ſtops it. That which the main-ſpring draws, and round which the chain or ſtring is wrapped, is called the *fuſy*; this is ordinarily taper; in large works, going with weights, it is cylindrical, and called the *barrel*. The ſmall teeth at the bottom of the fuſy or barrel, which ſtop it in winding up, is called the *ratchet*; and that which ſtops it when wound up, and is for that end driven up by the ſpring, the *garde-gut*. The wheels are various: the parts of a wheel are, the hoop or rim; the teeth, the croſs, and the collet or piece of braſs ſoldered on the arbor or ſpindle whereon the wheel is rivetted. The little wheels playing in the teeth of the larger are called *pinions*; and their teeth, which are 4, 5, 6, 8, &c. are called *leves*; the ends of the ſpindle are called *pivots*; and the guttered wheel, with iron ſpikes at bottom, wherein the line of ordinary clocks runs, the *pulley*. We need not ſay any thing of the hand, ſcrews, wedges, ſtops, &c. See WHEEL, FUSY, &c.

Perpetual MOVEMENT. Many have attempted to find a perpetual movement, but without ſucceſs; and there is reaſon to think, from the principles of mechanics, that ſuch a movement is impoſſible: for though, in many caſes of bodies acting upon one another, there is a gain of abſolute motion, yet the gain is always equal in oppoſite directions; ſo that the quantity of direct motion is never increaſed.

To make a perpetual movement, it appears neceſſary that a certain ſyſtem of bodies, of a determined number and quantity, ſhould move in a certain ſpace for ever, and in a certain way and manner; and for this there muſt be a ſeries of actions returning in a circle, otherwiſe the movement will not be perpetual; ſo that any action by which the abſolute quantity of force is increaſed, of which there are ſeveral ſorts, muſt have its correſponding counter-action, by which the gain is deſtroyed, and the quantity of force reſtored to its firſt ſtate.

Thus by theſe actions there will never be any gain of direct force to overcome the friction and reſiſtance of the medium; ſo that every motion being diminiſhed by theſe reſiſtances, they muſt at length languiſh and ceaſe.

MOUFET (Thomas), a celebrated Engliſh phyſician, was born at London, and practiſed medicine with great reputation. Towards the latter end of his life he retired to the country, and died about the year 1600. This phyſician is known by a work which was begun by Edward Wotton, and printed at London in

Moug-den || Mould.

1634, folio, with the title of *Theatrum Inſectorum.* A tranſlation of it into Engliſh was publiſhed at London in 1658, folio. Martin Liſter gives a very unfavourable opinion of this book: "As Mouſet (ſays he) made uſe of Wotton, Geſner, &c. an excellent work might have been expected from him; and yet his *Theatrum* is full of confuſion, and he has made a very bad uſe of the materials with which theſe authors have furniſhed him. He is ignorant of the ſubject of which he treats, and his manner of expreſſion is altogether barbarous. Beſides this, he is extremely arrogant, to ſay no worſe; for though he has copied Aldrovandus in innumerable places, he never once mentions his name." But Ray thinks that Liſter, by expreſſing himſelf in this manner, has not done juſtice to Mouſet; and he mantains that the latter has rendered an eſſential ſervice to the republic of letters.

MOUG-DEN, or CHEN-YANG; a city of Chineſe Tartary, and capital of the country of the Mantchews or eaſtern Tartars. Theſe people have been at great pains to ornament it with ſeveral public edifices, and to provide it with magazines of arms and ſtorehouſes. They conſider it as the principal place of their nation; and ſince China has been under their dominion, they have eſtabliſhed the ſame tribunals here as at Peking, excepting that called *Lii-pou:* theſe tribunals are compoſed of Tartars only; their determination is final; and in all their acts they uſe the Tartar characters and language. The city is built on an eminence: a number of rivers add much to the fertility of the ſurrounding country. It may be conſidered as a double city, of which one is encloſed within the other: the interior contains the emperor's palace, hotels of the principal mandarins, ſovereign courts, and the different tribunals; the exterior is inhabited by the common people, tradeſmen, and all thoſe who by their employments or profeſſions are not obliged to lodge in the interior. The latter is almoſt a league in circumference; and the walls which encloſe both are more than three leagues round: theſe walls were entirely rebuilt in 1631, and repaired ſeveral times under the reign of Kang-hi. — Near the gates are two magnificent tombs of the firſt emperors of the reigning family, built in the Chineſe manner, and ſurrounded by a thick wall furniſhed with battlements; the care of them is entruſted to ſeveral Mantchew mandarins, who at ſtated times are obliged to perform certain uſual ceremonies; a duty which they acquit themſelves of with the ſame marks of reſpect and veneration as if their maſters were ſtill living.

MOVING PLANTS. See HEDYSARUM, TREMELLA, and MIMOSA.

MOULD, or MOLD, in the mechanic arts, &c. a cavity artfully cut, with deſign to give its form or impreſſion to ſome ſofter matter applied therein. Moulds are implements of great uſe in ſculpture, foundery, &c. The workmen employed in melting the mineral or metallic glebe dug out of mines, have each their ſeveral moulds to receive the melted metal as it comes out of the furnace; but theſe are different according to the diverſity of metals and works. In gold mines, they have moulds for ingots; in ſilver mines, for bars; in copper and lead mines, for pigs or ſalmons; in tin mines, for pigs and ingots; and in iron mines, for ſows, chimney-backs, anvils, caldrons, pots, and other large utenſils and merchandizes of iron; which are here caſt, as it were, at firſt hand. Mould

MOULDS of founders of large works, as ſtatues, bells, guns, and other brazen works, are of wax, ſupported within ſide by what we call a core, and covered without-ſide with a cap or caſe. It is in the ſpace which the wax took up, which is afterwards melted away to leave it free, that the liquid metal runs, and the work is formed; being carried thither through a great number of little canals, which cover the whole mould. See FOUNDERY.

MOULDS of moneyers are frames full of ſand, wherein the plates of metal are caſt that are to ſerve for the ſtriking of ſpecies of gold and ſilver. See COINING.

A ſort of concave moulds made of clay, having within them the figures and inſcriptions of ancient Roman coins, are found in many parts of England, and ſuppoſed to have been uſed for the caſting of money. Mr Baker having been favoured with a ſight of ſome of theſe moulds found in Shropſhire, bearing the ſame types and inſcriptions with ſome of the Roman coins, gave an account of them to the Royal Society. They were found in digging of ſand, at a place called Ryton in Shropſhire, about a mile from the great Watling-ſtreet road. They are all of the ſize of the Roman denarius, and of little more than the thickneſs of our halfpenny. They are made of a ſmooth pot or brick clay, which ſeems to have been firſt well cleanſed from dirt and ſand, and well beat or kneaded, to render it fit for taking a fair impreſſion. There were a great many of them found together, and there are of them not unfrequently found in Yorkſhire; but they do not ſeem to have been met with in any other kingdom, except that ſome have been ſaid to be once found at Lyons. They have been ſometimes found in great numbers joined together ſide by ſide, on one flat piece of clay, as if intended for the caſting of a great number of coins at once; and both theſe, and all the others that have been found, ſeem to have been of the emperor Severus. They are ſometimes found impreſſed on both ſides, and ſome have the head of Severus on one ſide and ſome well known reverſe of his on the other. They ſeem plainly to have been intended for the coinage of money, though it is not eaſy to ſay in what manner they can have been employed to that purpoſe, eſpecially thoſe which have impreſſions on both ſides, unleſs it may be ſuppoſed that they coined two pieces at the ſame time by the help of three moulds, of which this was to be the middle one. If by diſpoſing theſe into ſome ſort of iron frame or caſe, as our letter-founders do the braſs moulds for caſting their types, the melted metal could be eaſily poured into them, it would certainly be a very eaſy method of coining, as ſuch moulds require little time or expence to make, and therefore might be ſupplied with new ones as often as they happen to break.

Theſe moulds ſeem to have been burnt or baked ſufficiently to make them hard; but not ſo as to render them porous like our bricks, whereby they would have loſt their ſmooth and even ſurface, which in theſe is plainly ſo cloſe, that whatever metal ſhould be formed in them would have no appearance like the ſand-

Mould. holes by which counterfeit coins and medals are uſually detected.

MOULDS of founders of ſmall works are like the frames of coiners: it is in theſe frames, which are likewiſe filled with ſand, that their ſeveral works are faſhioned; into which, when the two frames, whereof the mould is compoſed, are rejoined, the melted braſs is run.

MOULDS of letter-founders are partly of ſteel and partly wood. The wood, properly ſpeaking, ſerves only to cover the real mould which is within, and to prevent the workman, who holds it in his hand, from being incommoded by the heat of the melted metal. Only one letter or type can be formed at once in each mould. See LETTER-FOUNDERY.

MOULDS, in the manufacture of paper, are little frames compoſed of ſeveral braſs or iron wires, faſtened together by another wire ſtill finer. Each mould is of the bigneſs of the ſheet of paper to be made, and has a rim or ledge of wood to which the wires are faſtened. Theſe moulds are more uſually called frames or forms. See *PAPER-making*.

MOULDS, with furnace and crucible makers, are made of wood, of the ſame form with the crucibles; that is, in form of a truncated cone: they have handles of wood to hold and turn them with, when, being covered with the earth, the workman has a mind to round or flatten his veſſel.

MOULDS for leaden bullets are little iron pincers, each of whoſe branches terminates in a hemiſpherical concave, which when ſhut form an entire ſphere. In the lips or ſides where the branches meet, is a little jet or hole, through which the melted lead is conveyed.

Laboratory MOULDS are made of wood, for filling and driving all ſorts of rockets and cartridges, &c.

Glaziers MOULDS. The glaziers have two kinds of moulds, both ſerving to caſt their lead: in the one they caſt the lead into long rods or canes fit to be drawn through the vice, and the grooves formed therein; this they ſometimes call ingot-mould. In the other, they mould thoſe little pieces of lead a line thick and two lines broad, faſtened to the iron bars. Theſe may be alſo caſt in the vice.

Goldſmiths MOULDS. The goldſmiths uſe the bones of the cuttle-fiſh to make moulds for their ſmall works; which they do by preſſing the pattern between two bones, and leaving a jet or hole to convey the ſilver through, after the pattern has been taken out.

MOULD, among maſons, is a piece of hard wood or iron, hollowed within ſide, anſwerable to the contours of the mouldings or cornices, &c. to be formed. This is otherwiſe called *caliber*.

MOULDS, among plumbers, are the tables whereon they caſt their ſheets of lead. Theſe they ſometimes call ſimply *tables*. Beſides which they have other real moulds, wherewith they caſt pipes without ſoldering. See each deſcribed under PLUMBERY.

MOULDS, among the glaſs grinders, are wooden frames, whereon they make the tubes wherewith they fit their perſpectives, teleſcopes, and other optic machines. Theſe moulds are cylinders, of a length and diameter according to the uſe they are to be applied to, but always thicker at one end than the other, to facilitate the ſliding. The tubes made on theſe moulds are of two kinds; the one ſimply of paſteboard and paper; the other of thin leaves of wood joined to the paſteboard. To make theſe tubes to draw out, only the laſt or innermoſt is formed on the mould; each tube made afterwards ſerving as a mould to that which is to go over it, but without taking out the mould from the firſt. See GRINDING. Mould, Mouldineſs.

MOULDS uſed in baſket-making are very ſimple, conſiſting ordinarily of a willow or oſier turned or bent into an oval, circle, ſquare, or other figure, according to the baſkets, panniers, hampers, and other utenſils intended. On theſe moulds they make, or more properly meaſure, all their work; and accordingly they have them of all ſizes, ſhapes, &c.

MOULD, in ſhip-building, a thin flexible piece of timber, uſed by ſhipwrights as a pattern whereby to form the different curves of the timbers, and other compaſſing pieces in a ſhip's frame. There are two ſorts of theſe, viz. the bend-mould and hollow-mould; the former of theſe determines the convexity of the timbers, and the latter their concavity on the outſide, where they approach the heel, particularly towards the extremities of the veſſel. The figure given to the timbers by this pattern is called their *bevelling*.

MOULDS, among tallow-chandlers, are of two kinds: the firſt for the common dipped caddles, being the veſſel wherein the melted tallow is diſpoſed, and the wick dipped. This is of wood, of a triangular form, and ſupported on one of its angles; ſo that it has an opening of near a foot a-top: the other, uſed in the fabric of mould candles, is of braſs, pewter, or tin.—Here each candle has its ſeveral mould. See CANDLE.

MOULD, among gold-beaters, a certain number of leaves of vellum or pieces of guts cut ſquare, of a certain ſize, and laid over one another, between which they put the leaves of gold and ſilver which they beat on the marble with the hammer. See GOLD-LEAF.

They have four kinds of moulds; two whereof are of vellum and two of gut: the ſmalleſt of thoſe of vellum conſiſts of 40 or 50 leaves; the largeſt contains 100: for the others, each contain 500 leaves. The moulds have all their ſeveral caſes, conſiſting of two pieces of parchment, ſerving to keep the leaves of the mould in their place, and prevent their being diſordered in beating.

MOULD, in agriculture, a general name for the ſoft earthy ſubſtance with which the dry land is generally covered, and in which all kinds of vegetables take root and grow. It is, however, far from being an homogeneous ſubſtance; being compounded of decayed animal and vegetable matters, calcareous, argillaceous, and ſiliceous earths, all mixed together in various proportions, and with the different degrees of moiſture, conſtituting all the varieties of SOIL throughout the world. All kinds of mould contain ſome inflammable ſubſtance, which remains in them from the decayed animals and vegetables; and they are more or leſs black in proportion to the quantity of phlogiſton they contain. The black mould yields by diſtillation a volatile alkali and oil.

MOULDINESS, a term applied to bodies which corrupt in the air, from ſome hidden principle of humidity therein; and whoſe corruption ſhows itſelf by a certain white down or lanugo on their ſurface, which viewed through a microſcope appears like a kind of meadow, out of which ariſe herbs and flowers, ſome only in the bud, others full-blown, and others decayed; each having its root, ſtalk, and other parts. See MUCOR.

Moulding || Moulton.

MOULDING, any thing caſt in a mould, or that ſeems to have been ſo, though in reality it were cut with a chiſel or the ax.

MOULDINGS, in architecture, projectures beyond the naked wall, column, wainſcot, &c. the aſſemblage of which forms corniches, door-caſes, and other decorations of ARCHITECTURE. See that article.

MOULIN (Charles du), a celebrated civilian, and one of the moſt learned men of the 16th century, was born of a conſiderable family at Paris in 1500, and acquired great reputation by his ſkill in the law. He publiſhed many works, which have been collected together, and printed in five volumes folio; and are juſtly conſidered as the moſt excellent works that France has produced on the ſubject of civil law. He died at Paris in 1566.

MOULIN (Peter du), a Proteſtant divine, believed to be of the ſame family with the former, was born in 1568. He taught philoſophy at Leyden; and afterwards became chaplain to the princeſs of Navarre. At the king of England's deſire he came hither in 1615, and prepared a plan for the union of the Proteſtant churches. The univerſity of Leyden offered him a profeſſorſhip of divinity in 1619: but he refuſed it, and preſided at the ſynod held by the Calviniſts at Alais in 1620. Some time after, being informed by Mr Drelincourt that the French king reſolved to have him thrown into priſon, he retired to Sedan, where the duke de Bouillon made him profeſſor of divinity, and miniſter in ordinary. He was employed by the Calviniſts in the moſt important affairs; and died at Sedan in 1658. His principal works are, 1. The anatomy of Arminianiſm. 2. A treatiſe on repentance, and the keys of the church. 3. The Capuchine, or the hiſtory of thoſe monks. 4. The buckler of faith, or a defence of the reformed churches. 5. The judge of controverſies and traditions. 6. The anatomy of the maſs. 7. The novelty of Popery.

Peter du Moulin, his eldeſt ſon, was chaplain to Charles II. of England, and prebendary of Canterbury, where he died in 1684, aged 84. He wrote, 1. The peace of the ſoul, in French. 2. *Clamor regii ſanguinis*; which Milton, by miſtake, attributed to Alexander Morus. 3. A defence of the Proteſtant religion, in Engliſh.

MOULINET, is uſed, in mechanics, to ſignify a roller, which, being croſſed with two levers, is uſually applied to cranes, capſtans, and other ſorts of engines of the like nature, to draw ropes, and heave up ſtones, &c.

MOULINET is alſo a kind of turnſtile, or wooden croſs, which turns horizontally upon a ſtake fixed in the ground; uſually placed in paſſages to keep out horſes, and to oblige paſſengers to go and come one by one. Theſe moulinets are often ſet near the outworks of fortified places at the ſides of the barriers, through which people paſs on foot.

MOULINS, a town of France, and capital of Bourbonnois. The houſes of the Chartreux, and that of the Viſitation, are magnificent. It carries on a conſiderable trade in cutlery ware, and is ſeated on the river Allier, in a pleaſant fertile plain, almoſt in the middle of France, 30 miles ſouth of Nevers, and 55 north of Clermont. E. Long. 3. 25. N. Lat. 46. 34.

MOULTON (North), a town of Devonſhire on the river Moul, and the north ſide of South Moulton, of whoſe hundred it is a member, and anciently gave name to it, as the latter does now. It has two fairs, on Tueſday after May 11. and on Nov. 12.

Moulting || Mountain.

MOULTON (South), on the ſame ſtream, 182 miles from London. This, as well as the former, was anciently royal demeſne. This corporation, which once ſent members to parliament in the reign of Edward I. conſiſts of a mayor, 18 capital burgeſſes, a recorder, town-clerk, and 2 ſerjeants at mace. Here is a market on Saturdays; and fairs are held the firſt Tueſday after May 11. and Nov. 12. Their chief manufactures are ſerges, ſhalloons, and felts; and great quantities of wool brought from the country are bought up here every Saturday. In the year 1684, a merchant of London, a native of this town, built and endowed a free ſchool here; beſides which, here is a charity-ſchool.

MOULTING, or MOLTING, the falling off or change of hair, feathers, ſkins, horns, or other parts of animals, happening in ſome annually, in others only at certain ſtages of their life.

The generality of animals moult in the ſpring. The moulting of a hawk is called *mewing*. The moulting of a deer is the quitting of his horns in February or March. The moulting of a ſerpent is the putting off his ſkin. See EXUVIÆ.

MOUND, a term uſed for a bank or rampart, or other fence, particularly that of earth.

MOUND, in heraldry, a ball or globe with a croſs upon it, ſuch as our kings are uſually drawn with, holding it in their left hand, as they do the ſceptre in the right.

MOUNT, an elevation of earth, called alſo *mountain*. See MOUNTAIN.

Mount-Edgecumbe, a prodigious high peak, at the entrance of Cook's ſtrait, in New Zealand, on the weſt ſide. Its height is ſuppoſed not to be much inferior to that of the peak of Teneriffe.

Mount-Sorrel, a town in Leiceſterſhire, ſo named from a high mount or ſolid rock adjoining to the town, of a duſky red or ſorrel-coloured ſtone, extremely hard. Of rough ſtones hewn out of this rock the town is built. It has a market on Mondays. It was noted formerly for its caſtle, and is ſeated on the river Stour, over which there is a bridge. It is 20 miles ſouth-eaſt by ſouth of Derby, and 105 north-weſt by north of London. W. Long. 1. 9. N. Lat. 52. 45.

Mounts of Piety, certain funds or eſtabliſhments in Italy, where money is lent out on ſome ſmall ſecurity. There were alſo mounts of piety in England, raiſed by contribution for the benefit of people ruined by the extortions of the Jews.

MOUNTAIN (*Mons*), a conſiderable eminence of land, elevated above every thing adjoining to it, and commanding all the ſurrounding places: It is commonly full of inequalities, cavities more or leſs expoſed, and ſtrata half laid open.

This name is likewiſe given to a chain of mountains; as when we ſpeak of Mount Atlas in Africa; Mount Caucaſus, which begins above Colchis and ends at the Caſpian ſea; the Pyrenean mountains, which ſeparate France from Italy; and the Apennine mountains, which run through the whole of Italy.

Thoſe who have ſurveyed the earth in general, and ſtudied

Mountain. ſtudied nature on a grand ſcale, have conſtantly been ſtruck with admiration and aſtoniſhment at the ſight of ſuch majeſtic eminences, which extending in different ways, ſeem to rule over the reſt of the globe, and which preſent to the beholder a ſpectacle equally magnificent and intereſting. In them it has been ſuppoſed we muſt ſearch for a ſolution of the important problem regarding the creation of the world.

Naturaliſts reckon ſeveral kinds of mountains: we ſhall find that theſe elevations of the earth have not all the ſame origin, nor date their commencement from the ſame era.

1. Thoſe mountains which form a chain, and which are covered with ſnow, may be conſidered as *primitive* or antediluvian. They are like majeſtic bulwarks ſcattered on the ſurface of the globe, and greatly exceed the other mountains in height. In general, their elevation is very ſudden, and their aſcent very ſteep and difficult. Their ſhape is that of a pyramid crowned with ſharp and prominent rocks, on which no verdure is to be ſeen, but which are dry, naked, and as it were ſtripped of their ſoil, which has been waſhed away by the rains, and which preſent an awful and horrible aſpect, ſufficient to impreſs the coldeſt imagination with terror. Theſe primitive mountains, which aſtoniſh the eye, and where wind only reigns, are condemned by nature to perpetual ſterility. At the foot of them we frequently find paths leſs ſteep and winding than when we aſcend to a greater height. They every where preſent thundering caſcades, frightful precipices, and deep valleys. The depreſſions and excavations correſpond with the quantity of water, the motion of which is accelerated in its fall, and which ſometimes produces a total ſinking or an inclination of the mountain. The wrecks to be found at the foot of moſt peaks, ſhow how much they have ſuffered from the hand of time. Nothing meets the eye but enormous rocks, heaped in confuſion on one another, which prevent the approach of the human race. On the ſummits of theſe mountains or high eminences, which are only a ſeries of peaks frequently detached from one another, the prominent rocks are covered with eternal ſnow and ice, and ſurrounded with floating clouds which are diſperſed into dew. In a word, the rugged cliffs oppoſe an inacceſſible rampart to the intrepidity of man; and nature exhibits a picture of diſorder and decay (A). No ſhells or other organized marine bodies are to be found in the internal part of theſe primitive mountains; and though ſearch has been made, by digging, on the tops of the Alps and the Pyrenees, no ſubſtances of this nature have yet been diſcovered except on the ſides near the baſe. Nothing is to be met with but continued rocks, caverns dug by the hand of nature, and abounding in cryſtallizations of great beauty, with various minerals. The ſtone of which they conſiſt is an immenſe maſs of quartz, ſomewhat varied, which penetrates into the bowels of the earth in a direction almoſt perpendicular to the horizon. We find no calcareous ſpar but in the fiſſures or rents which have ſome extent and an evident direction; and at great depths we find new parts as it were, or, in other words, the primitive ſtate of things. All primitive mountains furniſh proofs of theſe aſſertions. Of this kind in Europe are the Pyrenees, the Alps, the Apennines, the mountains of Tirol, the mountain of the giants in Sileſia, the Carpathian mountains, the mountains of Saxony, thoſe of Norway, &c. In Aſia we find the Riphean mountains, Mount Caucaſus, Mount Taurus, and Mount Libanus; in Africa, the mountains of the moon; and in America the Apalachian mountains, and the Andes or Cordilleras. Many of the latter have been the ſeats of volcanoes. Mountain.

2. Another kind of mountains are thoſe which are either detached, or ſurrounded with groups of little hills, the ſoil of which is heaped up in diſorder, and the cruſt gravelly and confuſedly arranged together. Theſe are truncated or have a wide mouth in the ſhape of a funnel towards the ſummit, and which are compoſed of, or ſurrounded with, heaps of calcined and half vitrified bodies, lava, &c. This claſs of mountains appear to have been formed by different ſtrata raiſed up and diſcharged into the air, upon occaſion of the eruption of ſome ſubterraneous fire. The iſles of Santorin, Monte-Nuovo, Mount Etna, Adam's Peak in the iſland of Ceylon, the peak of Teneriffe in the Canary Iſlands, and many others, have been formed in this manner. When very high mountains of this kind are covered with ſea-ſhells, we may conſider their ſummits as having once conſtituted a part of the bottom of the ocean. A number of theſe mountains have been formed in the memory of man; and preſent nothing to the view but diſordered ruins, confuſed maſſes, parts heaped together in the greateſt irregularity, and productions formed by eruptions or by the falling in of the earth. When a mountain of this

(A) It is obſerved, ſays the Abbé Palaſſou, that at the foot of the Pyrenean mountains, the ſoil of ſeveral countries conſiſts wholly of the mud and rubbiſh depoſited by the rivers which deſcend from them. According to Herodotus, a great part of Egypt was in like manner formed by the different ſubſtances brought thither by the Nile: Ariſtotle calls it the work of the Nile; and on this account the Ethiopians boaſted that Egypt was indebted to them for its orign. The inhabitants of the Pyrenees might ſay the ſame thing of almoſt the whole tract of country ſituated along the northern chain from the ocean to the Mediterranean, forming that kind of iſthmus which ſeparates the two ſeas. The ſurface of our globe is thus in a ſtate of perpetual change; the plains are elevated, the mountains are levelled, and water is the principal agent employed by nature in theſe great revolutions. Time alone is wanting to verify the ſaying of Louis XIV. to his grandſon: Poſterity will one day be able to ſay, "The Pyrenees are no more." The period, however, muſt neceſſarily be very diſtant. M. Genſanne, from obſervations which he thinks well-founded, concludes, that theſe mountains are lowered about ten inches every century. Suppoſing them therefore to be 1500 toiſes above the level of the ſea, and always ſuſceptible of being lowered in the ſame degree, a million of years would elapſe before their total deſtruction.

Mountain. this kind is connected with the land, and advances farther into the ſea than the adjoining country, it is then termed a *Cape*, *Head*, or *Promontory*; ſuch as the Cape of Good Hope at the ſouthern extremity of Africa. Mountains of the ſecond rank are commonly more eaſy of acceſs. Dr Haller obſerves, that the angle formed between their baſe and their declivity is larger; that they have fewer ſprings; and that their plants are different from thoſe of the Alps. The peaſants in Swiſſerland, he tells us, are acquainted with the difference betwixt theſe two kinds of mountains.

3. Thoſe mountains, whether arranged in a group or not, the earth or ſtone of which is diſpoſed in ſtrata more or leſs regular, and conſiſting of one or more colours and ſubſtances, are produced by the ſubſtances depoſited ſlowly and gradually by the waters, or by ſoil gained at the time of great floods. We daily ſee little hills formed in this manner, which are always of a ſmall height compared with thoſe of the firſt order, and round in the top, or covered with ſoil frequently forming a pretty flat and extenſive ſurface. We there find likewiſe ſand and heaps of round pebbles like ſuch as have been worn by the waters. The internal part of theſe mountains conſiſts of a heap of ſtrata almoſt horizontal, and containing a prodigious quantity of ſhells, marine bodies, and fiſh-bones. Although theſe mountains formed by ſtrata ſometimes degenerate into little hills, and even become almoſt flat, they always conſiſt of an immenſe collection of foſſils of different kinds, in great preſervation, and which are pretty eaſily detached from their earthy bed whether harder or ſofter. Theſe foſſils, conſiſting of marine ſhells intermixed and confounded with heaps of organiſed bodies of another ſpecies, preſent a picture of aſtoniſhing diſorder, and give indubitable indications that ſome extraordinary and violent current has confounded and accumulated in the greateſt diſorder and precipitation foreign ſubſtances and ſhells of various kinds. Theſe, removed from their natural and original place, by their union form an elevation and a mountain, which are in fact nothing but a compoſition of the wrecks of bodies formerly organiſed. All theſe phenomena ſeem to prove, that moſt of theſe mountains chiefly owe their origin to the ſea, which once covered ſome parts of our continent, now left dry by its retreat. (According to the principles of this ſyſtem, Anaxarchus explained the formation of the mountains of Lampſacus). In theſe mountains we likewiſe find wood, prints of plants, ſtrata of clay, marl, and chalk, different beds of ſtone ſucceeding one another, ſuch as ſlate, marble which is often full of ſea ſhells, lime-ſtone which appears to be wholly formed from the wreck of ſhells, plaſter-ſtone, entire ſtrata of ochre, and beds of bitumen, mineral ſalt, and alum.

The ſtrata of mountains which are lower and of a recent date, or formed by recent accidents, ſometimes appear to reſt upon, or to take their riſe from, the ſides of primitive mountains which they ſurround, and of which they in ſome meaſure form the firſt ſteps in the aſcent; and they end by being inſenſibly loſt in the plains. With reſpect to the irregularity of ſome ſtrata in recent mountains, it is owing to violent and ſudden inundations, to torrents, and to local revolutions which have produced angles, leaps, and ſinkings down of the ſtrata. It is generally obſerved, however, that the ſtrata in mountains are exactly parallel to each other throughout all their different windings. M. Deſmareſt remarks, that in two mountains which by their brows form the hollow of a valley, we find ſtrata of earth or ſtone of the ſame kind, and diſpoſed and arranged in the ſame manner. We have already ſhown, under the article EARTH, why the ſtrata of recent mountains are not every where the ſame in number and thickneſs. Some ſtrata are only a quarter of an inch thick, others are more than ten feet: in ſome places we find 30 or 40 beds ſucceeding each other, in others only three or four. In recent mountains compoſed of ſtrata, M. Lehmann obſerves, the loweſt ſtratum is always pit-coal; and this reſts on a coarſe and ferruginous gravel or ſand. Above the pit-coal we find ſtrata of ſlate, ſchiſtus, &c. and the upper part of the ſtrata is conſtantly occupied by limeſtone and ſalt-ſprings. It is eaſy to perceive the utility of theſe obſervations, when we intend to work for theſe minerals; and by attending to the diſtinction which has been made of the different mountains of the ſame kind, we may know the nature of thoſe ſubſtances which upon ſearch we may expect to find in them. The ſpecimens which appear without, indicate what ſubſtances are concealed within.

In general, it has been obſerved, that when two or more mountains run parallel to each other, the ſalient angles correſpond with the receding ones; and theſe angles are ſharper and more ſtriking in deep and narrow valleys. Dr Haller obſerves, that there are many places in the Alps and in mountains, where two chains are prolonged contrary to the axis of the valley, and join ſo as only to leave as much ſpace as is neceſſary for the diſcharge of the water. In other places the mountain is continued, for inſtance, to the north, and diſcontinued to the ſouth, where it opens into a valley. In others, the two chains retire and form a bend on each ſide, the concavity of which fronts the axis: hence ariſe valleys almoſt round and completely united.

It is likewiſe worthy of obſervation, that primitive mountains which form vaſt chains are commonly connected together; that they ſucceed one another for a ſpace of ſeveral hundred leagues; and cover with their principal branches, and their various collateral ramifications, the ſurface of continents. Father Kircher and many others have obſerved, that the principal chain generally runs from ſouth to north, and from eaſt to weſt. The Cordilleras in the New world, Dr Haller obſerves, extend from north to ſouth; the Pyrenees have nearly the ſame direction; the Alps run from eaſt to weſt; and there muſt be a chain of this kind in Africa, for the great rivers in that quarter of the world run to the eaſt on the one ſide and to the weſt on the other. The chain of Thibet appears to be parallel to the Alps; and, from the great length of the road through the ſnows, it may be inferred that the mountains of Thibet have a very great elevation. Thoſe mountains which, ſtrictly ſpeaking, are the principal roots, and the capital point of elevation and diviſion, preſent very conſiderable maſſes, both with regard to their height and their ſize or extent: they commonly occupy and traverſe the centre of continents.

Mountain. Thoſe which have a ſmaller elevation ariſe from theſe principal chains; they gradually diminiſh in proportion to their diſtance from their root, and at length wholly diſappear either on the ſea-coaſt or in the plains. Others are continued along the ſhore of the ſea; their chain is interrupted only to make room for the waters of the ocean, under the bed of which the baſe of theſe mountains extends; and it again occurs in iſlands, which perpetuate their continuation till the whole chain re-appears. The higheſt mountains and the greateſt number of iſlands are generally found between or near the tropics, and in the middle of the temperate zones; while the loweſt are adjacent to the poles; though this does not always hold good without exception. M. Buache, a member of the Academy of Sciences at Paris, has laid down a ſyſtem of phyſical geography concerning the ſtructure of the terraqueous globe, conſidered with reſpect to the great chains of mountains which croſs the continents and ſeas from pole to pole, and from eaſt to weſt. According to this ſyſtem, there is an uninterrupted ſeries of mountains and high grounds which divide the earth into four declivities, from which the rivers deſcend. Theſe chains of mountains are continued from one continent to another under the ocean; and the iſlands which are obſerved in it, are as it were the ſummits of the mountains. M. Buache's work is entitled *Tables et Cartes de la Geographie phyſique*. But that this ſyſtem, with regard to the iſlands, muſt be erroneous, will appear evident from our article EARTH.

In the *Journal de Phyſique* for May 1779 we are informed, that Dr Pallas, who has travelled through Siberia, and almoſt all the Ruſſian empire in the north of Aſia, thinks he has diſcovered the inſufficiency of the principal ſyſtems hitherto propoſed to account for the formation of mountains. This accurate obſerver has proſecuted the ſtudy of mountains by traverſing immenſe regions, and viſiting as it were the ſecret work-ſhops of nature in almoſt the fourth part of our hemiſphere. He has not truſted to the vague reports of others, but from obſervations which he himſelf had occaſion to make for the ſpace of ten years. He has, in a work entitled *Obſervations on Mountains* explained both the direction of the northern chains, and the particular compoſition of each. He is thence led to make an ingenious conjecture concerning the formation of the principal groups of mountains, and concerning the irregular diſtribution and the figure of the old continent. Under the article EARTH an account is given of the different ſyſtems which have been formed concerning the formation and configuration of our globe. To eſtabliſh a general ſyſtem, it would perhaps be neceſſary to have travelled over the whole earth; and to have ſtudied all the chains of mountains, their direction, and particular compoſition, for a long ſeries of years. Thus very little attention is required to perceive, in the different ſyſtems mentioned under the article EARTH, the influence of climate and local ſituation. Burnet, Whiſton, and Woodward, who were acquainted only with England, where very few great chains of mountains are to be ſeen, where they are almoſt all inſulated or detached, and where the ſoil of extenſive plains is formed by horizontal and pretty regular ſtrata, naturally thought that theſe general and concentric ſtrata were to be found all around the globe, and conſidered mountains as nothing but the wrecks of theſe ſtrata, either raiſed or ſwallowed up by the violence of the waters. Scheuchzer, who ſtudied among the ſteep mountains of Switzerland, amid rocks of granite, petroſilex, jaſper, and hard ſtones, and who found nothing on the moſt elevated plains of the Alps but ſtrata of ſimilar ſubſtances, had recourſe to the power of the Almighty, who broke in pieces theſe ſtrata, and elevated their ſplinters into the form of mountains. Ray, Morro, and Stenon, who ſaw nothing all around them but burning mountains and traces of volcanic productions—deceived by the conſtitution of the hills of Italy, which are almoſt all formed of lava, pozzolana, and baſaltic ſubſtances, and by the origin of the Monte Nuovo, which roſe up almoſt before their eyes, have conſidered great mountains as formed by a cauſe which undoubtedly has a ſecondary, but to which they have aſcribed a primary and principal, influence. M. de Buffon, who delineated nature at the foot of the utmoſt extremity of the French Alps, and who perceived them gradually attain a greater elevation as they advanced towards the ſouthern parts of France and towards Savoy, concluded from his theory, and in ſupport of the ſame theory, that the higheſt mountains were near the equator; that they became lower towards the poles; and that, being produced by the flux and reflux of the ſea, they were formed of the ſubſtances which it depoſited. Mountain.

We ſhall now lay before our readers the geographical deſcription of the directions of the principal mountains, and of that kind of connection which ſubſiſts betwixt them. This deſcription differs from that of M Buache, and may be read with a map of the world before us.

M Buache places the moſt elevated points of the great chains of mountains under the equatorial line: but, according to the author whom we follow in this place, the fulleſt and moſt continuous lands, and perhaps likewiſe the moſt elevated, are to be found at a diſtance from the equator, and towards the temperate zones. If, in fact, we ſurvey the globe's ſurface, we will not be able to perceive that chain of mountains, which running from eaſt to weſt, and dividing the earth into two portions, ought again to meet. On the contrary, extenſive plains ſeem to accompany the line through almoſt its whole extent. In Africa, the deſerts of Nigritia and thoſe of Upper Ethiopia, are on the one ſide of the line; and on the other are the ſandy plains of Nicoco, Caffraria, Monoemugi, and Zanguebar. From the eaſtern ſhores of Africa to the Sunda iſlands, is a ſpace of 1500 leagues of ſea with almoſt no iſlands, except the Laccadive and Maldive iſlands; moſt part of which have little elevation, and which run from north to ſouth. From the Molucca iſlands and New Guinea, to the weſtern borders of America, the ſea occupies a ſpace of 3000 leagues. Though Chimboraço and Pichincha in America the two higheſt mountains which have been meaſured, are near and even under the line, yet from this no concluſion can be drawn; becauſe on one ſide theſe mountains run in a direction not parallel to the equator; the Andes or Cordilleras attain a greater elevation as they remove from the equator towards the poles; and a vaſt plain is found exactly under the line, between the Oroonoko and the river of the Amazons. Beſides, the latter river, Mountain.

which

Mountain.

which takes its riſe in the province of Lima about the 11th degree of ſouth latitude, after croſſing the whole of South America from weſt to eaſt, falls into the ocean exactly under the equator. This ſhows that there is a deſcent for the ſpace of 12 degrees or 300 leagues. From the mouth of the river of the Amazons, to the weſtern ſhores of Africa, the ſea forms another plain of more than 50 degrees.

From the few certain facts and accurate obſervations which we have received from well informed travellers, we might almoſt affirm that the moſt elevated land on our globe is ſituated without the tropics in the northern and ſouthern hemiſpheres. By examining the courſe of the great rivers, we in fact find that they are in general diſcharged into three great reſervoirs, the one under the line, and the other two towards the poles. This, however, we do not mean to lay down as a thing univerſally true; for it is allowed, that, beſides the two elevated belts, the whole ſurface of the earth is covered with innumerable mountains, either detached from one another or in a continued chain. In America, the Oronooko and the river of the Amazons run towards the line, while the river St Lawrence runs towards the 50th degree of north latitude, and the river de la Plata towards the 40th degree of ſouth latitude. We are ſtill too little acquainted with Africa, which is almoſt all contained within the tropics, to form any accurate concluſions concerning this ſubject. Europe and Aſia, which form only one great maſs, appear to be divided by a more elevated belt, which extends from the moſt weſterly ſhores of France to the moſt eaſterly of China, and to the iſland of Sagaleen or Anga-hata, following pretty nearly the 50th degree of north latitude. In the new continent, therefore, we may conſider that chain where the Miſſiſſippi, the river St Lawrence, the Ohio, and the river de los Eſtrechos, take their riſe, as the moſt elevated ſituation in North America: whence the Miſſiſſippi flows towards the equator, the river St Lawrence towards the north-eaſt, and the reſt towards the north-weſt. In the old continent, the belt formerly mentioned, and to which we may aſſign about 10 degrees in breadth, may be reckoned from the 45th to the 55th degree of north latitude: for in Europe the Tagus, the Danube, the Dnieper, the Don, and the Volga, and in Aſia the Indus, the Ganges, the Meran, the Mecon, the Hoang-ho, and the Yantg-tſe-Kiang, deſcending as it were from this elevation, fall into the great reſervoir between the tropics; whilſt towards the north the Rhine, the Elbe, the Oder, the Viſtula, the Obi, the Jeniſei, the Lena, the Indigirka, and the Kowyma, are diſcharged into the northern reſervoir.

Judging from thoſe mountains the height of which has been calculated, and from the immenſe chains with which we are acquainted, we may infer that the higheſt mountains are to be found in this elevated belt. The Alps of Swiſſerland and Savoy extend through the 45th, the 46th, and the 47th degrees. Among them we find St Gothard, Furca, Bruning, Ruſs, Whiggis, Scheidek, Gunggels, Galanda, and laſtly that branch of the Swiſs Alps which reaches Tirol by the name of Arlenberg and Arula. In Savoy, we meet with Mount Blanc, the Peak of Argentiere, Cornero, Great and Little St Bernard, Great and Little Cenis, Coupeline, Servin, and that branch of the Savoyard Alps which proceeds towards Italy through the duchy of Aoſt and Montſerrat. In this vaſt heap of elevated peaks, Mont Blanc and St Gothard are particularly diſtinguiſhed. The Alps, leaving Swiſſerland and Savoy, and paſſing through Tirol and Carniola, traverſe Saltzbourg, Stiria, and Auſtria, and extend their branches through Moravia and Bohemia, as far as Poland and Pruſſia.—Between the 47th and 48th degrees, we meet with Grimming the higheſt mountain of Stiria, and Priel which is the higheſt in Auſtria. Between the 46th and 47th degrees, the der Bacher and the der Reinſchnicken, form two remarkable chains. The upper one, which traverſes the counties of Trencſin, Arrava, Scepus, and the Kreyna, ſeparates Upper Hungary from Sileſia, Little Poland, and Red Ruſſia; the inferior one traverſes Upper Croatia, Boſnia, Servia, and Tranſilvania, ſeparates Lower Hungary from Turkey in Europe, and meets the upper chain behind Moldavia, on the confines of Little Tartary. In theſe mountains are ſituated the rich mines of Schemnitz.

Mountain.

To form a general idea of the great height of this Alpine belt, it is neceſſary only to remark, that the greateſt depth of the wells at Schemnitz is 200 toiſes; and yet it appears, from the barometrical calculations of the learned M. Noda, that the greateſt depth of theſe mines is 286 toiſes higher than the city of Vienna. The granito-argillous mountains of Schemnitz, and of the whole of this metallic diſtrict, are inferior, however, to the Carpathian mountains. Mount Krivany in the county of Arrava, and the Carpathian mountains between Red Ruſſia and the Kreyna, appear by their great elevation to rule over the whole of the upper Alpine chain. In the inferior chain we likewiſe meet with mountains of an extraordinary height; among others, Mount Mediednik, which gives its name to a chain extending far into Boſnia; and Mount Hemus, celebrated even among the ancients. In ſhort, this extenſive chain reaches into Aſia, and is there confounded with another chain no leſs famous, which, following exactly the 50th degree of latitude, runs through the whole of Aſia. This chain of mountains is deſcribed by Dr Pallas in the work above-mentioned; and we ſhall now trace its courſe in company with this intelligent obſerver.

This author places the head of the mountains of Oural, between the ſources of the Taik and the Bielaïa, about the 53d degree of latitude, and the 47th of longitude. Here the European Alps, after having traverſed Europe, and ſent off various branches which we ſhall afterwards examine, loſe their name, which is changed into that of the Ouralic or Uralian mountains, and begin their courſe in Aſia. This lofty chain, which ſeparates Great Bulgaria from the deſarts of Iſchimſka, proceeds through the country of the Eleuths, follows the courſe of the river Irtis, approaches the lake Teleſkaia, and afterwards forms a part of the ſame ſyſtem of mountains with the Altaic chain. There they give riſe to the Oby, the Irtis, and the Jeniſei, which begin their courſe about the 50th degree of north latitude, and fall into the Frozen Ocean.

The Altaic chain, after having embraced and united all the rivers which ſupply the Jeniſei, is continued

Mountain. under the name of *Saianes*, without the ſmalleſt interruption, as far as the Baikal lake. The extenſion of this chain to the ſouth forms that immenſe and elevated plain which is loſt in Chineſe Tartary, which may be compared with the only plain in Quito, and which is called *Gobi* or *Chamo*. The Altai afterwards interpoſing between the ſource of the Tchikoi and of the rivers which ſupply the Amur or Sagaleen, riſes towards the Lena, approaches the city Jakuck beyond the 60th degree of latitude, runs from that to the ſea of Kamtſchatka, turns round the Ochockoi and Penſink gulphs, joins the great marine chain of the Kurile iſles near Japan, and forms the ſteep ſhores of Kamtſchatka, between the 55th and 60th degrees of latitude. Such is the direct courſe of the high mountains conſtituting the belt which, we imagine, is to be found in the northern hemiſphere, and which, after becoming lower, paſſing under the ſea, and forming by means of their elevated peaks that archipelago of iſlands which derives its name from the unfortunate Bhering, again riſe and enter North America, on the weſtern ſide, about the Straits of Anian. After running in the ſame parallel, and giving riſe to the Ohio, the Riviere-Longue, the river St Lawrence, and the Miſſiſſippi, they are loſt in Canada. From the eaſtern ſhores of America to the weſtern ſhores of Europe, we find a vaſt interruption. Perhaps the chain was at firſt continued completely round the globe; but extraordinary revolutions, by ſeparating the old and new continents, may have occaſioned this diviſion, and left nothing but the Azores and ſome detached points as a monument of what formerly exiſted, till we come to the Britiſh iſles.

Before we proceed to inquire whether a belt of a ſimilar elevation exiſts in the ſouthern hemiſphere, we may remark thoſe branches and ramifications which the great northern Alpine belt ſends forth both towards the equator and the antarctic pole. Theſe new chains, which gradually become lower as they approach the boundary towards which they tend, appear a ſufficient proof that the equator is not the moſt elevated part of the earth.

The European Alps produce three principal chains, which run towards the equator, and ſome ſmaller ones running towards the pole. The firſt ſouthern chain is ſent out through Dauphiné; traverſes Vivarais, Lyonnois, Auvergne, Cevennes, and Languedoc; and, after joining the Pyrenees, enters Spain. There it divides into two or three ramifications, one of which runs through Navarre, Biſcay, Arragon, Caſtile, Marche, and Sierra Morena, and extends into Portugal. The other, after traverſing Andaluſia and the kingdom of Granada, and there forming a number of ſierras, again makes its appearance, beyond the Straits of Gibraltar, in Africa, and coaſts along its northern ſhores under the name of *Mount Atlas*.—The ſecond principal chain of the Alps paſſes out through Savoy and Piedmont; ſpreads its roughneſſes over the ſtates of Genoa and Parma; forms the belt of the Apennines; and after frequently changing its name, and dividing Italy into two parts, terminates in the kingdom of Naples and in Sicily, producing volcanoes in every part of its courſe. The third chain is ſent off from Hungary, and ſcatters innumerable mountains over all Turkey in Europe, as far as the Morea and the Archipelago at the bottom of the Mediterranean ſea. The northern branches, though ſmaller at firſt, are no leſs clearly defined; and ſome of them even extend their ramifications as far as the Frozen Ocean. An Alpine branch, iſſuing from Savoy thro' the country of Gex, proceeds through Franche Comte, Suntgaw, Alſace, the Palatinate, and Veterabia.—Another iſſues from the territory of Saltzbourg, paſſes along Bohemia, enters Poland, ſends off a ramification into Pruſſia towards the deſerts of Waldow, and after having paſſed through Ruſſia is loſt in the government of Archangel. Mountain.

The Aſiatic Alps ſend forth in like manner ſeveral branches both to the ſouth and north. The Ouralic mountains, between the ſources of the Bielaia and the Jaik, produce three principal branches; the firſt of which, including the Caſpian Sea in one of its diviſions, enters Circaſſia through the government of Aſtracan, paſſes through Georgia under the name of *Caucaſus*, ſends a vaſt number of ramifications to the weſt into Aſiatic Turkey, and there produces the mountains Tſchilder, Ararat, Taurus, Argée, and many others in the three Arabias; while the other diviſion, paſſing between the Caſpian Sea and the lake Aral, penetrates through Choraſan into Perſia. The ſecond branch, taking a more eaſterly direction, leaves the country of the Eleuths; reaches Little Bucharia; and forms the ramparts of Gog and Magog, and the celebrated mountains formerly known by the name of *Caf*, which M. Bailly has made the ſeat of the war between the Dives and the Peris*. It traverſes the kingdoms of Caſgar and Turkeſtan, enters through that of Lahor into the Mogul territory, and, after giving riſe to the elevated deſert of Chamo forms the weſtern peninſula of India. While theſe two branches run towards the ſouth, the third branch of the Ouralic chain riſes towards the north, following almoſt the 79th degree of longitude, and forms a natural boundary between Europe and Aſia; without, however, bounding the immenſe empire of Ruſſia. This chain, after coming oppoſite to Nova Zembla, divides into two conſiderable branches. The one, running to the north-eaſt, paſſes along the Arctic ſhores; the other, proceeding towards the north-weſt, meets the northern European chain, traverſes Scandinavia in the ſhape of a horſe-ſhoe, covers the low-lands of Finland with rocks; and, as is obſerved by Dr Pallas, appears to be continued from the North Cape of Norway through the marine chain of Spitzbergen, ſcattering iſlands and ſhelves perhaps throughout the northern ocean, that, paſſing through the pole, it may join the northern and eaſtern points of Aſia and North America.

* *Lettres ſur les Atlantides*, let. 16.

The Ouralic, which in the country of the Mongols becomes the Altaic chain, proceeds towards the equator. After forming the mountains and caverns wherein, as we are told, the aſhes of the Mongol emperors of the race of Ghengis-Kan are depoſited, together with the vaſt plain of Chamo, conſiſting of arid ſand, and the frightful rocks and precipices of Thibet, which form the myſterious and deſert retreats of the Grand Lama, it croſſes the rivers Ava and Menan; contains in its ſubdiviſions the kingdoms of Ava, Pegu, Laos, Tonquin, Cochinchina, and Siam; ſupports the peninſula of Malacca; and overſpreads the Indian ocean with the iſles of Sonda, the Moluccas, and the Philippines. From the borders of the Baikal lake and of the province of Selinginſkoy,

Mountain. ginſkoy, a branch is detached, which ſpreads over Chineſe Tartary and China, is continued into Corea, and gives riſe to the iſlands of Japan.

The great chain having extended to the north, near the city of Jakuck, upon the banks of the Lena, ſends off one of its branches to the north-weſt, which paſſing between the two Tunguſta, is loſt in marſhy grounds lying in the northern parts of the province of Jenniſſeiſkoy. The ſame chain, after it has reached the eaſtern part of Aſia, is loſt in the icy regions of the north about Nos-Tſchalatſkoy or the icy Promontory, and Cap Czuczenſkoy.

It will be more difficult, perhaps, to trace the elevated belt in the ſouthern hemiſphere beyond the tropic of Capricorn, than it has been to diſtinguiſh that towards the north. An immenſe extent of ocean ſeems to occupy the whole Antarctic part of the globe. The greateſt ſouth latitude of the old continent is not more than 34 degrees, and South America ſcarcely extends to the 55th degree. In vain has the enterpriſing Cook attempted to diſcover regions towards the pole: his progreſs was conſtantly interrupted by tremendous mountains and fields of ice. Beyond the 50th degree no land and no habitation is to be found. The iſlands of New Zealand are the fartheſt land in theſe deſert ſeas; and yet the ſouth cape of Taral-Poenamoo extends only to the 48th degree: We do not mention Sandwich-land, which is ſituated in the 58th degree, becauſe it is too ſmall and too low. It muſt be recollected, however, that according to the declarations of travellers, the Cordilleras become higher as they advance ſouthward to the Straits of Magellan; and that the Terra del Fuego, which lies in the latitude of 55, is nothing but a maſs of rocks of prodigious elevation. America, however, exhibits to our view elevated points, whence chains of mountains are diſtributed in different directions over the whole ſurface of the new continent. There muſt likewiſe be great reſervoirs, where the moſt remarkable rivers take their riſe, and from which they neceſſarily deſcend towards their mouth. In the ſouthern hemiſphere, this elevated belt is nearer the equator; and though it does not extend to the 50th degree, it is evidently to be met with and may be accurately traced between the 20th and 30th degrees. The high mountains of Tucuman and of Paraguay, which interſect South America about the 25th degree of latitude, may be conſidered as the American Alps. If we look into the map of the world, we will be able to diſtinguiſh an elevated belt all along this parallel. In Africa, Monomotapa and Caffraria are covered with very high mountains, from which pretty large rivers deſcend. In the Pacific Ocean, we find New Holland, New Caledonia, the New Hebrides, and the Friendly and the Society iſlands, under the ſame parallel. We may, therefore, with ſufficient propriety, diſtinguiſh this parallel by the name of the *Southern Alps*, as we have already diſtinguiſhed the elevated belt of the 50th degree of north latitude by that of the *Northern Alps*. In America, the Rio de la Plata, which after a courſe of 500 leagues falls into the ocean at the 35th degree of ſouth latitude; the Pavana, which riſes from the mountains of the Arapes, and falls into the Plata at Corriente; the great number of rivers which flow into that of the Amazons, ſuch as the Paraba, which receives in its courſe the tribute of more than 30 other rivers; the Madera, the Cuchirara, the Ucayal, &c. &c. all deſcend from theſe ſouthern Alps. From theſe Alps likewiſe three conſiderable branches of mountains are detached, which go by the common name of *Andes* or *Cordilleras*.—The firſt branch, which extends towards the ſouth, and paſſes out from Paraguay through Tucuman, ſeparates Chili from theſe provinces and from Chimito, and is continued through the Terra Magellanica as far as Terra del Fuego. The ſecond branch, directing its courſe towards the equator, traverſes Peru, in vain endeavouring to conceal treaſures which the avarice of men has taught them to diſcover in its bowels; bounds the Spaniſh Miſſions; enters Terra Firma thro' Popayan; and unites South and North America by the iſthmus of Panama. The third diviſion, iſſuing from Paraguay through Guayra and the territory of Saint-Vincent, traverſes Brazil, diſtributes ramifications into Portugueſe, French, and Dutch Guiana, croſſes the Oroonoko, forms the mountains of Venezuela, and near Carthagena meets the ſecond branch coming from Popayan. Mountain.

We have already ſuppoſed, that the elevated belt of North America was ſituated about the 45th degree of north latitude; and there we imagined we recognized the continuation of the northern Alps of the old continent. This chain likewiſe ſends forth conſiderable branches on both ſides. One of them is detached acroſs the ſources of the Miſſiſſippi, the Belle-Riviere, and the Miſſouri, and at the entrance of New Mexico divides, in order to form California to the weſt, and the Apalachian mountains to the eaſt.—Thence proceeding through New Biſcay, the audience of Guadalaxara, Old Mexico, and Guatimala, it meets at Panama the ſouthern branch, which is part of the Alps of Paraguay. The ſecond branch, following the courſe of the Miſſiſſippi, ſeparates Louiſiana from Virginia; ſerves as a bulwark to the United States of America; forms the Apalachian mountains in Carolina; and at laſt, traverſing Eaſt Florida, incloſes the Gulph of Mexico with the Great and Little Antilles. In the north, we can trace the branches of the elevated belt; on one ſide obſerve them proceeding towards Canada, directing their courſe through Labrador to Hudſon's Straits, and at length confounded with the rocks of Greenland, which are covered with eternal ſnow and ice. On the other ſide, we ſee them riſing through the country of the Aſſinipoels and the Kriſtinos, as far as Michinipis and the northern Archipelago.

We have thus traced the directions of the great chains of mountains. There are certain projecting and pretty ſenſible points on the globe, which appear to ſupply every region with great rivers and high mountains. The Alps of Switzerland and Savoy in Europe, the union of the Ouralic mountains in Aſia, (B) the Andes of Tucuman and Paraguay in South America, and the high countries, whence the Miſſiſſippi,

(B) Theſe M. Bailly conſiders as the moſt elevated art of the globe. *Lettres ſur les Atlantides*, p. 236.

Mountain. ſſippi, the river Saint Lawrence, and the Belle Riviere deſcend, may be conſidered as ſome of theſe; though M. Buache places them much nearer the equator, and even under the line. But his object was to form a ſyſtem to ſupport his own, and to confirm another; ours is merely to ſtate what we have obſerved, and what indeed muſt occur to every one who ſurveys the ſurface of the globe as it is delineated by our beſt geographers.

So many obſervations fully ſhow that the primitive mountains may be conſidered as the foundation of our globe. By their ſhape, elevation, direction, and continuity, they give riſe to the greateſt part of winds, or produce that variety which prevails among them. Primitive mountains, as we have already ſaid, are diſtinguiſhed likewiſe by their internal ſtructure, by the nature of the ſtones of which they are compoſed, and by the minerals which they contain. The higheſt mountains are, properly ſpeaking, nothing but peaks or cones conſiſting of ſolid rock. This pyramidal form has been ſuppoſed to be at firſt owing to a kind of cryſtallization; and the late M. Rouelle was of opinion, that the ſubſtances of which our globe is compoſed originally ſwam in a fluid. The ſimilar parts of which the great mountains conſiſt, according to this philoſopher, approached one another and formed a cryſtallization, ſometimes in a group, and at other times detached at the bottom of the waters. Upon this ſuppoſition, we might analyſe different portions or blocks of rock taken from primitive mountains; and by making them cryſtalliſe, we would then have in miniature a part of the ſame economy or connection of mountains, a figurative portion, in ſhort, of the ſkeleton of the earth.—We may farther preſume, that thoſe ſteep rocks which it now ſeems almoſt impoſſible to ſurmount even in imagination, are co-eval with the exiſtence of the world.

Mountains with flat ſummits ſometimes reſt on the baſe of primitive mountains; and contain marble, foſſils, and limeſtone. When mountains of the ſame kind poſſeſs a round and more regular ſhape, they conſiſt of chalk and other calcareous and friable ſubſtances arranged in ſtrata. Granite-argillous mountains, like thoſe of Shemnitz, generally form metallic diſtricts. Hills compoſed of brown free-ſtone every where preſent irregular points, indicating broken ſtrata and heaps of rubbiſh.

Dr Pallas (in the ſyſtematic part of the Memoir above mentioned, concerning the ſubſtances of which the higheſt mountains are compoſed) lays it down as an axiom, that the higheſt mountains of the globe forming continued chains, are compoſed of that rock which is called *granite*, the baſe of which is always a quartz, with a greater or ſmaller mixture of felt-ſpar, mica, and ſmall ſchoerls, ſcattered without order, and in irregular fragments of different ſizes. This old rock, and the ſand ariſing from its decompoſition, form the baſe of all continents. Granite is found below mountains compoſed of ſtrata (this obſervation is not applicable to the courſes of mountains formed by ſtrata); it conſtitutes the large protuberances, and as it were the heart, of the greateſt Alps in the known world: hence we may with the greateſt probability infer, that this rock forms the principal ingredient in the internal compoſition of our globe. It is never found in regular ſtrata, but in huge maſſes and in ſhapeleſs blocks; its origin is prior to that of all animated beings; it exhibits not the ſmalleſt traces of petrifaction, and ſeems not to have received the leaſt impreſſion from any organiſed ſubſtance. High eminences, whether in continued chains or in the form of ſteep peaks, are never covered with clayey or calcareous ſtrata, deriving their origin from the ſea; but appear to have been from their very firſt formation elevated above the level of the ocean. The ſides of theſe great chains are for the moſt part covered with ſchiſtous belts, and ſurrounded with mountains of the ſecond and third orders. This is proved by the Ouralic and Altaic chains, which have been traced by Dr Pallas. Such is the ſyſtem propoſed by this author. The high or primitive and ancient mountains, which have exiſted from the beginning of time, are granitous; the ſchiſtous mountains, to which he gives the name of *ſecondary*, have ariſen from the ſides of the primitive by the decompoſition of the granite; and thoſe which he calls *tertiary* mountains, or mountains of the third order, are nothing but ſubſtances depoſited by the ſea, and raiſed up by volcanoes, or ſwept away by a violent irruption, a powerful inundation, or an univerſal deluge. This hypotheſis concerning the formation of mountains is borrowed from nature itſelf, and appears to be confirmed by many facts in natural hiſtory. Mountain.

We ſhall now proceed to ſtate the height of moſt of the primitive mountains; an object no leſs worthy of attention than their ſtructure and variety.

According to M. Pontoppidan, the higheſt mountains in Norway are 3000 toiſes in height. According to M. Brovallius, the higheſt mountains in Sweden are 2333 toiſes. It is ſuppoſed, however, that both theſe calculations are erroneous.

From the Memoirs of the Academy of Sciences at Paris, it appears, that the mountains in France moſt elevated above the ſurface of the Mediterranean are the Puy-de-Dome, which is 817 toiſes, and the Mont d'Or, which is 1048 toiſes. Theſe two mountains are in Auvergne, and are ſuppoſed to be extinguiſhed volcanoes. Mount Cantal is 993 toiſes high: Mount Ventoux is 1036: the ſouth peak of Canigou in the Pyrenees, according to M. de Rocheblave, is 1442; and according to M. de Plantade, 1453: and Saint Barthelemi is 1184.

M. Needham obſerves, that the higheſt Alps in Savoy are the convent of the great Saint Bernard, at the point of the rock to the ſouth-weſt of that mountain, which is 1274 toiſes; Mount Sérené, which is 1283; and Mount Tourné, which is 1683. According to the meaſurement of the Engliſh obſerver, the peak or needle of Argentiere is 2094 toiſes high. M. Facio de Duiller and M. Duluc make the ridge of Mont Blanc 2213 toiſes; but according to the obſervation of M. Shuckburgh, its elevation is 2447 toiſes one foot (by M. de Sauſſure's meaſurement 2426 toiſes) above the level of the Mediterranean.

The principal mountains of the Alps are among the moſt elevated in the world; and particularly Mont-Blanc, that enormous maſs of granite, which is ſituated in the centre of the Alps, and the acceſs to which is rendered ſo difficult by the ſharp peaks, walls of ice, and everlaſting ſnows wherewith it is covered, is the

Mountain. highest mountain which has been measured either in Europe, Asia, or Africa. The altitude of the Alps of Switzerland has been ascertained by different philosophers: We shall content ourselves with mentioning the most remarkable of those mountains covered with snow, which in Switzerland are called *Gletschers* or *Glaciers*. St Gothard, according to Scheuchzer, is 1650 toises; and Lignon, near the lake of Como, north-east, is, according to Pini, 1486 toises in height. M. Pasumot, engineer to the king of the French, justly observes, that the heights assigned by Mikheli to the mountains of Switzerland appear rather to be ideal computations than founded on observations. An opinion of them may be formed from the following: According to this author, Mount Pilate or Frakmont, in the district of Lucerne, is 1403 toises in height; Mount Cenis, 1445; Raukhstok, 1760; the Nolle ridge of Titlisberg, 2001; Ghemi, 2421; Grimselberg, in the canton of Berne, 2539; the Cornera, part of Loukmanier, 2654; Fourke, 2669; Schrekhorn, 2724; and St Gothard, at its most elevated point, 2750. Mikheli likewise reckons 20 other mountains, the height of which exceeds 2000 toises. The reader may consult the *Table comparative des hauteurs des principales montagnes*, by M. Pasumot (*Journal de Physique*, September 1783.)

Throughout the globe we will not perhaps meet with higher mountains than those of Peru, which go by the name of *Cordilleras de los Andos*. According to the observations of the academicians sent to South America in 1735 by the Spanish and French courts to measure a degree of the meridian and to ascertain the true figure of the earth, the principal summits of these extraordinary mountains, which are situated near Quito, and which are constantly covered with snow though they lie under the equator, have the following geometrical elevations above the level of the sea: Quito-Capilate, 1707 toises; El-Corason, 2470 (c); Cotacatche, 2570; Ek-Atlas, 2730; and Noyamble-orcu, under the line, 3030. All the other mountains have been, or still are, volcanoes. The following is an enumeration of them, together with their several heights: Pichincha, 2430; Cargavi-raso, 2450; Sinchonalagon or Sinchoulagoa, 2570; Sangai, 2680; Illinika, 2717, Kotopaxi, 2950; Antisana, 3020; Cagambeorcon, situated under the line, 3030; Cimboraso or Chimboraço, 3220. The last mentioned mountain, which forms part of the Cordilleras in Peru, is one of the largest and probably the highest in the world. It is seen at sea from the gulph of Guayaquil, which is more than 60 leagues distant. Mountains.

Other very elevated mountains are Mount Sinai in Japan; Mount Caucasus in Asia; the southern peak of the Pyrenees; the peak of Teneriffe in one of the Canary islands, which according to M. Bouguer is 2100 toises (according to later observations, made by M. M. de Verdun, de Borda, and Pingré, French academicians, in 1754, the peak of Teyde, more commonly known by the name of the *peak of Teneriffe*, is only 1904 toises perpendicular height above the level of the sea); Mount Gibel or Etna in Sicily is 1672 toises; St George's peak in the Azores; Adam's peak in Ceylon; the mountains of the Moon; Mounts Athos, Olympus, Taurus, and Emaus; Mount Cenis in the Alps on the road from France to Italy, is 1460 toises; the Great and Little Atlas; and many others, on the top of which we feel, even in the middle of summer, a more piercing cold than that of the severest frosts of our climates. After this, it cannot appear wonderful that the vapours which reach so great heights are there congealed; and that the summits of these mountains, even in the warmest climates, are constantly covered with snow, while the inhabitants of the plain enjoy a temperate atmosphere, or are subject to extreme heat. The height of these mountains, added to their being placed on the most elevated parts of the globe, is the chief cause of the phenomena peculiar to them. In that part of Asia which is separated by the chain of mountains called the *Ghauts*, there are two very different seasons at one and the same time. While it is winter on the Malabar coast, for instance, the Coromandel coast, which has the same degree of elevation, and in some places is only 20 leagues distant, enjoys an agreeable spring or the temperature of autumn. The traveller in the Alps generally experiences, even in summer, the four seasons of the year. In the Andes we meet with a change of temperature no less curious; for as we descend from their summit to their base, we experience all the varieties of heat and cold which are felt in every climate of the earth, at whatever season (d). There are many other mountainous countries in which we pass at once from a serene sky to dreadful

(c) This is the greatest height to which any person is known to have ascended in America: the greatest elevation which has been reached in the Alps is the top of Mont-Blanc, which is 2426 toises, and which Dr Paccard ascended on the 8th of August 1786. M. de Saussure arrived there likewise on the 3d of August 1787, accompanied by 17 persons.

(d) The more we are elevated above the surface of the earth, it becomes the colder; and accordingly the tops of the highest mountains are always covered with snow. At the height of about 2300 toises above the level of the sea no plant whatever is found to grow: and it appears from the observations of MM. de la Condamine, Bouguer, Godin, Dom George Juan, and Dom Antonio de Ulloa, the academicians sent to Quito in 1735, that at the height of 2434 the snow is perpetual, and never melts at any time of the year even under the equator. The congelation begins and continues in all the mountains of the Cordilleras at the same height above the level of the sea, which is determined by an equal elevation of the mercury in the barometer. But from experiments which have been made, Sir Isaac Newton concludes, that the density of the atmosphere at any height is as the weight of the incumbent air, that is, as the height of the mercury in the barometer; and consequently the density of the air is the same in the whole region of the atmosphere, where the congelation is continual, and where that perpetual cold commences which is felt on all mountains. Above this constant height the density of the air continues to diminish, and the cold becomes greater and greater till we

Mountain. dreadful ſtorms and tempeſts. It cannot therefore be doubted, that mountains have a great influence on the temperature of the countries to which they belong, by ſtopping the courſe of certain winds, by forming barriers to the clouds, by reflecting the ſun's rays, and by ſerving as elevated conductors to the electricity of the atmoſphere. It was formerly ſaid by travellers, that on the peak of Teneriffe they found that brandy loſt its ſtrength; that ſpirit of wine became almoſt inſipid; that pepper, ginger, and ſalt, had little or no taſte when applied to the tongue; but, it was alleged, that Canary wines ſtill retained their taſte on that mountain. Theſe ſtories appeared too marvellous not to require new experiments; and MM. de Lamanon and Mongez, who viſited this peak in 1785, tell us, that the flavour and taſte of liquors appeared to have ſuſtained no loſs at that height: (See the experiments made on the Pic du Midi in the Pyrences by M. Darcet, in the *Journal de Phyſique* for November 1776; and a journey to the peak of Teneriffe, in the ſame *Journal* for Auguſt 1785). At the foot, and ſometimes at the middle, of thoſe lofty mountains, the tops of which are always covered with ſnow, we frequently find ſprings which begin to run in May and dry up in September. When the ſun approaches near enough to the tropic to warm the ſummits of theſe mountains, the ſnow with which they are covered melts, filtrates through their interior part, and iſſues forth at their baſe. The only trees which grow on mountains of this kind are firs, pines, and other reſinous trees; and the graſs becomes ſhorter towards their ſummit.

Mountains were not formed to be an uſeleſs load upon the earth, but evidently anſwer very important purpoſes; and we cannot enough admire their form and that kind of harmony which is diſcernible in their arrangement. Some of them, vomiting out fire or ſmoke, lava, and ſulphur, indicate that they in ſome meaſure anſwer the purpoſe of a chimney to ſomething within the earth, which, if confined, would burſt it in pieces: (See Volcano.) Of this kind are Mount Hecla in Iceland, Mount Etna in Sicily, Mount Veſuvius in the kingdom of Naples, Pichincha and Cotopaxi in America, &c. Others, the ſummits of which reach into the clouds, attract and abſorb the vapours of the ſea, &c. which float in the air. It is obſerved by M. l'Abbé Palaſſon, that ſtorms are moſt frequent at the foot of thoſe high mountains which form extenſive chains. Their enormous maſſes, which ſeem to ſupport the heavens on their ſhoulders, arreſt and fix the different meteors as they are formed. The clouds, in like manner, driven by the winds from different points of the horizon, there meet with impenetrable barriers, are there accumulated in great quantity, and remain ſuſpended on theſe bulwarks of the globe's ſurface, till the agitation of the atmoſphere ſucceeding the calm, produces ſtorms, which are ſo much the more terrible that they cannot expand and be diſperſed but with great difficulty. They are commonly repelled from the mountains; and are then obſerved to ſpread over whole countries, to diſſolve with peals of thunder, and to fall down in deſtructive hail-ſhowers fatal to the harveſt and to the whole produce of the fields. This ſcourge is peculiarly dreadful during the ſeaſons of ſpring and ſummer, when a ſufficient quantity of ſnow remains on the mountains to cool the atmoſphere. Mountain.

Some chains of mountains have openings; in others they are wanting: of the former kind are the ſtraits of Thermopylæ, the Caſpian ſtraits, the paſs of the Cordilleras, &c.

Thoſe ſpaces which ſeparate the tops of mountains are ſo many baſons deſtined for the reception of the condenſed miſts, and of the clouds precipitated into rain. The bowels of mountains appear to be great and inexhauſtible reſervoirs, and to contain ſubterraneous canals and lateral openings formed by the hand of nature, that the ſeveral ſpecies of animals may be ſupplied with drink, that the earth may be fertiliſed, and that nouriſhment may be afforded for the growth of vegetables. The ſtreams and rivers deſcend from the ridges of mountains, the declivities of which form ſo many inclined plains: Thus we find the Alps give riſe to the Rhine, the Danube, the Rhone, and the Po. With regard to the wonderful ſtructure, by means of which ſo many advantages are obtained, ſee the articles Earth, Springs, &c.

Mountains of the firſt order form vaſt ſolitudes and horrid deſerts, where the habitations of men are not to be ſeen, and their footſteps are ſeldom to be traced. By their grandeur, their elevation, the variety of their poſitions, the ſublime and awful exhibition of wonders which they contain, they elevate the mind and fire the imagination of the obſerver. But theſe majeſtic eminences have other advantages which deſerve our attention. They form the common retreat of a multitude of wild beaſts, which are ſubſervient to our uſe: there the bear, the lynx, the ermine, the martin, the fox, and many other animals, the ſkin of which we employ for furs, take up their abode; and thither the eagle and the vulture reſort in ſafety. Mountains likewiſe afford nouriſhment to rein-deer, buffaloes, fallow-deer, roe-deer, and chamois; and they are viſited by birds of paſſage which, under the guidance of inſtinct, follow the ſhorteſt road to the place of their deſtination. They produce medicinal plants, which almoſt never grow elſewhere. In Swiſſerland they are alſo covered with deep foreſts, which, by the great height of the trees, announce their antiquity. They afford both timber and fuel, and ſupply the inhabitants with abundance of excellent paſture for their beſtial during the whole ſummer. The moſt precious ſtones, both for brilliancy and hardneſs, acquire their forms and colours in the fiſſures of the rocks: the internal rents of mountains are filled and in a manner cemented by different metallic ſubſtances; while the grottos are furniſhed with numerous congelations, ſhining

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we reach the ſummits of the mountains, which preſent to our view all the horrors of winter as they are felt in the polar regions. But below this height, as the denſity of the air becomes greater in conſequence of being conſtantly preſſed upon by a great ſuperincumbent weight, the ſun's heat increaſes, ſo that thoſe who inhabit the plains at the foot of the mountain are expoſed to all the inconveniences of the torrid zone.

Mountain. shining cryſtals, and ſubſtances of an extraordinary nature and figure. In ſhort, every thing concurs to ſhow, that the exiſtence of mountains is abſolutely neceſſary; and that in order to acquire a proper knowledge of them, they muſt be conſidered in many different points of view. Their poſition, their direction, their elevation, the extent of their baſe, their figure, their various external windings, their internal ſtructure; in a word, every thing relating to the theory of the globe, and to the different temperatures of the atmoſphere, muſt engage the obſerver's attention; and by ſtudying and carefully examining the general conſtitution of mountains, the particular facts which they preſent to our view, their influence, their action on the atmoſphere, the different ſubſtances of which they are compoſed, together with the arrangement and mixture of theſe ſubſtances, we may at length diſcover the true mechaniſm of the earth. The reader may conſult the *Eſſais Sur l'etude des Montagnes; Journal de M. l'Abbé Rozier*, November 1773.

The difficulty and danger of aſcending to the tops of mountains proceeds not from the thinneſs of the air, as has been commonly reported; but the reaſon is, that they riſe with ſuch a rugged and precipitate aſcent, that they are utterly inacceſſible. In ſome places they appear like a great wall of 600 or 700 feet high; in others, there ſtick out enormous rocks, that hang upon the brow of the ſteep, and every moment threaten deſtruction to the traveller below.

In this manner almoſt all the tops of the higheſt mountains are bare and pointed: and this naturally proceeds from their being ſo continually aſſaulted by thunders and tempeſts. All the earthy ſubſtances with which they might have been once covered, have for ages been waſhed away from their ſummits; and nothing is left remaining but immenſe rocks, which no tempeſt has hitherto been able to deſtroy.

Nevertheleſs, time is every day and every hour making depredations; and huge fragments are ſeen tumbling down the precipice, either looſened from the ſummit by the froſt or rains, or ſtruck down by lightning. Nothing can exhibit a more terrible picture than one of theſe enormous rocks, commonly larger than an houſe, falling from its height with a noiſe louder than thunder, and rolling down the ſide of the mountain. Dr Plot tells us of one in particular, which being looſened from its bed, tumbled down the precipice, and was partly ſhattered into a thouſand pieces. Notwithſtanding, one of the largeſt fragments of the ſame, ſtill preſerving its motion, travelled over the plain below, croſſed a rivulet in the midſt, and at laſt ſtopped on the other ſide of the bank! Theſe fragments, as was ſaid, are often ſtruck off by lightning and ſometimes undermined by rains; but the moſt uſual manner in which they are diſunited from the mountain is by froſt: the rains inſinuating between the interſtices of the mountain, continue there until there comes a froſt; and then, when converted into ice, the water ſwells with an irreſiſtible force, and produces the ſame effect as gun-powder, ſplitting the moſt ſolid rocks, and thus ſhattering the ſummits of the mountain.

But not rocks alone, but whole mountains, are, by various cauſes, diſunited from each other. We ſee, in many parts of the Alps, amazing clefts, the ſides of which ſo exactly correſpond with the oppoſite, that no doubt can be entertained of their having been once joined together. At Cajeta in Italy, a mountain was ſplit in this manner by an earthquake; and there is a paſſage opened through it, that appears as if elaborately done by the induſtry of man. In the Andes theſe breaches are frequently ſeen. That at Thermopylæ in Greece has been long famous. The mountain of the Troglodytes in Arabia has thus a paſſage through it; and that in Savoy, which nature began and which Victor Amadeus completed, is an inſtance of the ſame kind. Mountain.

We have accounts of ſome of theſe diſruptions immediately after their happening. "In the month of June, in the year 1714, a part of the mountain of Diableret, in the diſtrict of Valais in France, ſuddenly fell down, between two and three o'clock in the afternoon, the weather being very calm and ſerene. It was of a conical figure, and deſtroyed 55 cottages in the fall. Fifteen perſons, together with about 100 beaſts, were alſo cruſhed beneath its ruins, which covered an extent of a good league ſquare. The duſt it occaſioned inſtantly covered all the neighbourhood in darkneſs. The heaps of rubbiſh were more than 300 feet high. They ſtopped the current of a river that ran along the plain, which now is formed into ſeveral new and deep lakes. There appeared, through the whole of this rubbiſh, none of thoſe ſubſtances that ſeemed to indicate that this diſruption had been made by means of ſubterraneous fires. Moſt probably, the baſe of this rocky mountain was rotted and decayed; and thus fell, without any extraneous violence." In the ſame manner, in the year 1618, the town of Pleurs in France was buried beneath a rocky mountain, at the foot of which it was ſituated.

Theſe accidents, and many more that might be enumerated of the ſame kind, have been produced by various cauſes: by earthquakes, as in the mountain at Cajeta; or by being decayed at the bottom, as at Diableret. But the moſt general way is, by the foundation of one part of the mountain being hollowed by waters, and, thus wanting a ſupport, breaking from the other. Thus it generally has been found in the great chaſms in the Alps; and thus it almoſt always is known in thoſe diſruptions of hills which are known by the name of *land-ſlips*. Theſe are nothing more than the ſliding down of an higher piece of ground, diſrooted from its ſituation by ſubterraneous inundations, and ſettling itſelf upon the plain below.

There is not an appearance in all nature that ſo much aſtoniſhed our anceſtors as theſe land-ſlips. In fact, to behold a large upland, with its houſes, its corn, and cattle, at once looſened from its place, and floating as it were upon the ſubjacent water; to behold it quitting its ancient ſituation, and travelling forward like a ſhip, in queſt of new adventures; this is certainly one of the moſt extraordinary appearances that can be imagined; and, to a people ignorant of the powers of nature, might well be conſidered as a prodigy. Accordingly, we find all our old hiſtorians mentioning it as an omen of approaching calamities. In this more enlightened age, however, its cauſe is very well known; and, inſtead of exciting ominous apprehenſions in the populace, it only gives riſe to ſome

Mountain. ſome very ridiculous law-ſuits among them, about whoſe the property ſhall be; whether the land which has thus ſlipt ſhall belong to the original poſſeſſor or to him upon whoſe grounds it has encroached and ſettled. What has been the determination of the judges is not ſo well known; but the circumſtances of the ſlips themſelves have been minutely enough and exactly deſcribed.

In the lands of Slatberg, in the kingdom of Ireland, there ſtood a declivity gradually aſcending for near half a mile. In the year 1713, and on the 10th of March, the inhabitants perceived a crack on its ſide, ſomewhat like a furrow made with a plough, which they imputed to the effects of lightning, as there had been thunder the night before. However, on the evening of the ſame day, they were ſurpriſed to hear an hideous confuſed noiſe iſſuing all round from the ſide of the hill; and their curioſity being raiſed, they reſorted to the place. There, to their amazement, they found the earth for near five acres all in gentle motion, and ſliding down the hill upon the ſubjacent plain. This motion continued the remaining part of the day and the whole night: nor did the noiſe ceaſe during the whole time; proceeding, probably, from the attrition of the ground beneath. The day following, however, this ſtrange journey down the hill ceaſed entirely; and above an acre of the meadow below was found covered with what before compoſed a part of the declivity.

However, theſe ſlips, when a whole mountain's ſide ſeems to deſcend, happen but very rarely. There are ſome of another kind, however, much more common; and, as they are always ſudden, much more dangerous. Theſe are ſnow-ſlips, well-known, and greatly dreaded by travellers. It often happens, that when ſnow has long been accumulated on the tops and on the ſides of mountains, it is borne down the precipice either by means of tempeſts or its own melting. At firſt, when looſened, the volume in motion is but ſmall: but it gathers as it continues to roll; and by the time it has reached the habitable parts of the mountain, it is generally grown of enormous bulk. Wherever it rolls, it levels all things in its way, or buries them in unavoidable deſtruction. Inſtead of rolling, it ſometimes is found to ſlide along from the top; yet even thus it is generally as fatal as before. Nevertheleſs, we have had an inſtance, a few years ago, of a ſmall family in Germany that lived for above a fortnight beneath one of theſe ſnow-ſlips. Although they were buried during that whole time in utter darkneſs, and under a bed of ſome hundred feet deep, yet they were luckily taken out alive, the weight of the ſnow being ſupported by a beam that kept up the roof, and nouriſhment ſupplied them by the milk of a ſhe-goat that was buried under the ſame ruin.

Attraction of Mountains. This is a late diſcovery, and a very conſiderable confirmation of Sir Iſaac Newton's theory of univerſal gravity. According to the Newtonian ſyſtem, an attractive power is not only exerted between thoſe large maſſes of matter which conſtitute the ſun and planets, but likewiſe between all comparatively ſmaller bodies, and even between the Mountain. ſmalleſt particles of which they are compoſed. Agreeably to this hypotheſis, a heavy body, which ought to gravitate or tend toward the centre of the earth, in a direction perpendicular to its ſurface, ſuppoſing the ſaid ſurface to be perfectly even and ſpherical, ought likewiſe, though in a leſs degree, to be attracted and tend towards a mountain placed on the earth's ſurface; ſo that a plumb-line, for inſtance, of a quadrant, hanging in the neighbourhood of ſuch a mountain, ought to be drawn from a perpendicular ſituation, in conſequence of the attractive power of the quantity of matter of which it is compoſed acting in a direction different from that exerted by the whole maſs of matter in the earth, and with a proportionably inferior degree of force.

Though Sir Iſaac Newton had long ago hinted at an experiment of this kind, and had remarked, that "a mountain of an hemiſpherical figure, three miles high and ſix broad, would not, by its attraction, draw the plumb-line two minutes out of the perpendicular (E):" yet no attempt to aſcertain this matter by actual experiment was made till about the year 1738; when the French academicians, particularly Meſſrs Bouguer and Condamine, who were ſent to Peru to meaſure a degree under the equator, attempted to diſcover the attractive power of Chimboraço, a mountain in the province of Quito. According to their obſervations, which were however made under circumſtances by no means favourable to an accurate ſolution of ſo nice and difficult a problem, the mountain Chimboraço exerted an attraction equal to eight ſeconds. Though this experiment was not perhaps ſufficient to prove ſatisfactorily even the reality of an attraction, much leſs the preciſe quantity of it; yet it does not appear that any ſteps had been ſince taken to repeat it.

Through the munificence of his Britannic majeſty, the royal ſociety were enabled to undertake the execution of this delicate and important experiment; the aſtronomer-royal was choſen to conduct it. After various inquiries, the mountain Schehallien, ſituated nearly in the centre of Scotland, was pitched upon as the moſt proper for the purpoſe that could be found in this iſland. The obſervations were made by taking the meridian zenith diſtances of different fixed ſtars, near the zenith, by means of a zenith ſector of ten feet radius; firſt on the ſouth, and afterwards on the north ſide of the hill, the greateſt length of which extended in an eaſt and weſt direction.

It is evident, that if the maſs of matter in the hill exerted any ſenſible attraction, it would cauſe the plumb-line of the ſector, through which an obſerver viewed a ſtar in the meridian, to deviate from its perpendicular ſituation, and would attract it contrarywiſe at the two ſtations, thereby doubling the effect. On the ſouth ſide the plummet would be drawn to the northward, by the attractive power of the hill placed to the northward of it: and on the north ſide, a contrary and equal deflection of the plumb-line would take

(E) By a very eaſy calculation it is found that ſuch a mountain would attract the plumb-line 1′ 1.8″ from the perpendicular.

Mountain. take place, in conſequence of the attraction of the hill, now to the ſouthward of it. The apparent zenith diſtances of the ſtars would be affected contrarywiſe; thoſe being increaſed at the one ſtation which were diminiſhed at the other: and the correſpondent quantities of the deflection of the plumb-lime would give the obſerver the ſum of the contrary attractions of the hill, acting on the plummet at the two ſtations; the half of which will of courſe indicate the attractive power of the hill.

The various operations requiſite for this experiment laſted about four months; and from them it appears, that the ſum of the two contrary attractions of the mountain Schehallien, in the two temporary obſervations which were ſucceſſively fixed half-way up the hill (where the effect of its attraction would be greateſt), was equal to 11″. 6.—From a rough computation, founded on the known law of gravitation, and on an aſſumption that the denſity of the hill is equal to the mean denſity of the earth, it appears that the attraction of the hill ſhould amount to about the double of this quantity. From thence it was inferred, that the denſity of the hill is only about half the mean denſity of the earth. It does not appear, however, that the mountain Schehallien has ever been a volcano, or is hollow; as it is extremely ſolid and denſe, and ſeemingly compoſed of an entire rock.

The inference drawn from theſe experiments may be reduced to the following:

"1. It appears, that the mountain Schehallien exerts a ſenſible attraction; therefore, from the rules of philoſophiſing, we are to conclude, that every mountain, and indeed every particle of the earth, is endued with the ſame property, in proportion to its quantity of matter.

"2. The law of the variation of this force, in the inverſe ratio of the ſquares of the diſtances, as laid down by Sir Iſaac Newton, is alſo confirmed by this experiment. For if the force of attraction of the hill had been only to that of the earth as the matter in the hill to that of the earth, and had not been greatly increaſed by the near approach to its centre, the attraction thereof muſt have been wholly inſenſible. But now, by only ſuppoſing the mean denſity of the earth to be double to that of the hill, which ſeems very probable from other conſiderations, the attraction of the hill will be reconciled to the general law of the variation of attraction in the inverſe duplicate ratio of the diſtances, as deduced by Sir Iſaac Newton from the compariſon of the motion of the heavenly bodies with the force of gravity at the ſurface of the earth; and the analogy of nature will be preſerved.

"3. We may now, therefore, be allowed to admit this law, and to acknowledge, that the mean denſity of the earth is at leaſt double of that at the ſurface; and conſequently that the denſity of the internal parts of the earth is much greater than near the ſurface. Hence alſo, the whole quantity of matter in the earth will be at leaſt as great again as if it had been all compoſed of matter of the ſame denſity with that at the ſurface; or will be about four or five times as great as if it were all compoſed of water.—This concluſion, Mr Maſkelyne adds, is totally contrary to the hypotheſis of ſome naturaliſts, who 'ſuppoſe the earth to be only a great hollow ſhell of matter; ſupporting itſelf from the property of an arch, with an immenſe vacuity in the midſt of it.' But, were that the caſe, the attraction of mountains, and even ſmaller inequalities in the earth's ſurface, would be very great, contrary to experiment, and would affect the meaſures of the degrees of the meridian much more than we find they do; and the variation of gravity, in different latitudes, in going from the equator to the poles, as found by pendulums, would not be near ſo regular as it has been found by experiment to be. Mountain.

"4. As mountains are by theſe experiments found capable of producing ſenſible deflections of the plumb-lines of aſtronomical inſtruments; it becomes a matter of great importance, in the menſuration of degrees in the meridian, either to chooſe places where the irregular attractions of the elevated parts may be ſmall; or where, by their ſituation, they may compenſate or counteract the effects of each other."

For meaſuring the heights of mountains, ſee the article BAROMETER.

Burning Mountains. See ÆTNA, HECLA, VESUVIUS, and VOLCANO.

Marble Mountains. Of theſe there are great numbers in Egypt, from which, though immenſe quantities have been carried off for the multitude of great works erected by the ancient Egyptians; yet, in the opinion of Mr Bruce who paſſed by them in his journey to Abyſſinia, there is ſtill ſuch an abundant ſupply, that it would be ſufficient to build Rome, Athens, Corinth, Syracuſe, Memphis, Alexandria, and half a dozen more of ſuch cities.

The firſt mountain of this kind mentioned by Mr Bruce is one oppoſite to Terfowey, conſiſting partly of green marble, partly of granite, with a red bluſh upon a grey ground, and ſquare oblong ſpots. Here he ſaw a monſtrous obeliſk of marble, very nearly ſquare, broken at the end, and nearly 30 feet long and 19 feet in the face. Throughout the plain there were ſcattered ſmall pieces of jaſper, with green, white, and red ſpots, called in Italy *diaſpro ſanguineo;* and all the mountains upon that ſide ſeemed to conſiſt of the ſame materials. Here alſo were quantities of ſmall pieces of granite of various kinds, as well as porphyry, which had been carried down by a torrent, probably from the ancient quarries. Theſe pieces were white mixed with black ſpots, and red with green veins and black ſpots. All the other mountains on the right hand were of red marble, but no great beauty; thoſe on the oppoſite ſide being green marble, probably of the ſerpentine kind. This, he ſays, was one of the moſt extraordinary ſights he ever ſaw. The former mountains were of a conſiderable height, without a tree, ſhrub, or blade of graſs upon them; and this looked exactly as if it had been covered over with Havannah and Brazil ſnuff. Proceeding farther on, he entered another defile with mountains of green marble on every ſide. The higheſt he ſaw appeared to be compoſed of ſerpentine marble; having a large vein of green jaſper ſpotted with red running through about one-third of its thickneſs. It was extremely hard; ſo that it did not yield to the blows of a hammer, though it was evident that it had formerly been quarried; and there were channels for bringing water, which terminated

Mountain. nated in this quarry of jaſper; "a proof (ſays Mr Bruce) that water was one of the means uſed in cutting thoſe hard ſtones."

On theſe mountains, our author obſerves, that "the porphyry ſhows itſelf by a fine purple ſand without any gloſs upon it, though the colour is very agreeable to the eye. It is mixed with the white ſand and fixed marble of the plains. Green and unvariegated marble is alſo found in the ſame mountain with the porphyry. The marble is brittle for ſome inches where the two veins meet; but the porphyry is as hard as in other places. The granite appears like a dirty brown ſtone covered with ſand; but this is only the change made upon it by the ſun and weather; for on breaking it, the colour appears to be grey with black ſpots, and a reddiſh caſt on the ſurface. The reddiſh colour appears to be impaired by expoſure to the atmoſphere; but is recovered upon poliſhing it anew. It is in greater quantity than the porphyry, and nearer to the Red Sea. The granite is next to the porphyry, but never joined with it in the ſame mountain. Being covered with a reddiſh ſand, it looks as if the whole mountain were covered with brick-duſt." There is likewiſe a kind of red marble with white veins, which our author has ſeen at Rome and likewiſe in Britain. The common green, called *ſerpentine*, looks as if it were covered with Brazil ſnuff. Along with this green he ſaw two ſamples of the beautiful kind called *Iſabella*; one of them with the yelloviſh caſt of Quaker-colour, the other of that bluiſh caſt called *dove-colour*; and theſe two ſeemed to divide the mountains with the ſerpentine. Here alſo he ſaw the vein of jaſper; but had not time to determine whether it was the ſame with that called bloody-jaſper or blood-ſtone or not.

The marble of greateſt value, however, is that called *Verde Antico*, which is of a dark-green colour with white ſpots. It is found, like the jaſper, in the mountains of the plain green ſerpentine, and is not diſcoverable by the duſt or any particular colour upon it. "Firſt (ſays Mr Bruce) there is a blue flaky ſtone exceedingly even and ſmooth in the grain, ſolid, and without ſparks and colour. When broken it is ſomething lighter than a ſlate, and more beautiful than moſt kinds of marble; it is like the lava of volcanoes when poliſhed. After lifting this we come to the beds of verde antico; and here the quarrying is very obvious; for it has been uncovered in patches not above 20 feet ſquare. Then, in another part, the green ſtone has been removed and another pit wrought." In other places of the plain he ſaw pieces of African marble, but no rocks or mountains of it. He ſuppoſes it to be found in the heart of ſome other coloured marble, and in ſtrata like the jaſper and verde antico; and, as he ſuſpects, in the mountains of Iſabella marble, eſpecially of the yelloweſt ſort. This vaſt ſtore of marble is placed on a ridge, whence there is a deſcent to the eaſt and weſt, ſo that it could be conveyed either to the Nile or the Red Sea. The level ground and hard fixed gravel are proper for the heavieſt carriages; ſo that any weight whatever might eaſily be conveyed to the place of embarkation. In the more diſtant mountains alſo he obſerved the ſame care taken to facilitate the carriage: for the defiles between thoſe mountains he ſuppoſes not to be natural but artificial openings; and he obſerved the roads from them to the Nile to be cut with a deſcent of about one foot in 50 at moſt; ſo that, all the way down, the carriages muſt have moved with as little draught as poſſible, at the ſame time that the vaſt friction would prevent any undue acceleration; to which alſo ſome other means muſt have contributed: But thus, he thinks, it may be explained how ſuch immenſe blocks might have been removed as were employed in the ancient Egyptian works. Mountain.

Mountains of marble and porphyry are not peculiar to Egypt, for they are likewiſe to be met with in the north of Scotland; and in the Weſtern Iſles there are likewiſe ſuch quantities of theſe materials to be met with, as, in the opinion of Mr Williams, would be ſufficient to ſerve all Europe.

Written MOUNTAIN, *Mountain of Inſcriptions*, or *Jibel-al-Mokatteb*, a ſuppoſed mountain, or chain of mountains, in the wilderneſs of Sinai; on which, for a great extent of ſpace, the marble of which the mountain conſiſts is inſcribed with innumerable characters, reaching from the ground ſometimes to the height of 12 or 14 feet. Theſe were mentioned by a Greek author in the third century, and ſome of them have been copied by Pococke and other late travellers; notwithſtanding which, there is ſtill a very great uncertainty even of the *exiſtence* of ſuch mountain or mountains. The vaſt number of theſe inſcriptions, the deſart place in which they are found, and the length of time requiſite for executing the taſk, has induced a notion by no means unnatural, that they are the work of the Iſraelites during their forty years wandering in the wilderneſs. Others are of opinion that they contain nothing of any importance, but conſiſt merely of the names of travellers and the dates of their journeys.

M. Niebuhr, who viſited this country about 30 years ago, made every attempt in his power, though without ſucceſs, to obtain a ſight of this celebrated mountain. On applying to ſome Greeks at Suez, they all declared that they knew nothing of the written mountain: they, however, directed him to an Arabian ſheik, who had paſſed all his lifetime in travelling between Suez and Mount Sinai; but he knew no more of it than the former. Underſtanding, however, that a conſiderable reward would be given to any perſon who would conduct them thither, this Arab directed them to another; who pretended not only to know that mountain, but all others upon which there were any inſcriptions throughout the deſart. On inquiring particularly, however, our travellers found that he was not to be depended upon; ſo that they were obliged to have recourſe to a fourth ſheik, who by his converſation convinced them that he had ſeen mountains with inſcriptions in unknown characters upon them. It does not appear, however, that this perſon was very capable, more than the reſt, of leading them to the place they ſo much wiſhed for; though he conducted them to ſome rocks upon which there were inſcriptions in unknown characters. They are moſt numerous in a narrow paſs between two mountains named *Om-er-ridſtein*; and, ſays M. Niebuhr, "the pretended Jebel-el-Mokatteb may poſſibly be in its neighbourhood." Some of theſe inſcriptions were copied by our author; but he does not look upon them to be

Mountain. of any consequence. "They seem (says he) to have been executed at idle hours by travellers, who were satisfied with cutting the unpolished rock with any pointed instrument, adding to their names and the date of their journeys some rude figures, which bespeak the hand of a people but little skilled in the arts. When such inscriptions are executed with the design of transmitting to posterity the memory of such events as might afford instructive lessons, greater care is generally taken in the preparation of the stones, and the inscriptions are engraven with more regularity."

When M. Niebuhr arrived at last at the mountain to which the sheik had promised to conduct him, he did not find there any inscriptions; but on climbing up to the top, he found nothing there but an Egyptian cemetery, the stones of which were covered with hieroglyphics. The tomb-stones are from five to seven feet in length, some standing on end and others lying flat; and "the more carefully they are examined (says he), the more certainly do they appear to be sepulchral stones, having epitaphs inscribed on them. In the middle of these stones is a building, of which only the walls now remain; and within it are likewise a great many of the sepulchral stones. At one end of the building seems to have been a small chamber, of which the roof still remains. It is supported upon square pillars; and these, as well as the walls of the chamber, are covered with hieroglyphic inscriptions. Thro' the whole building are various busts executed in the manner of the ancient Egyptians. The sepulchral stones and the busts are of hard and fine-grained sand-stone." M. Niebuhr is of opinion that this cemetery was not the work of the Egyptians themselves, but of some colony which came from Egypt, and had adopted the manners and customs of the people. He supposes that it might have been built by the Arabs who had conquered Egypt under the shepherd kings and adopted the Egyptian manners during their residence there. As it must have belonged to an opulent city, however, he owns that there is a great difficulty in accounting for the existence of such a city in the midst of a desart.

The translator of Volney's travels ascribes these inscriptions to the pilgrims which visit Mount Sinai. But to this, as well as to every other conjecture, there is this objection, that whether the inscriptions be well executed or not, whether they contain matters of importance or not, they ought to have been written in a language which *somebody* could understand; but from the copies that have been taken of them by Dr Pococke and others, it does not appear that they could be explained either by him or any other person.

When Dr Clayton, bishop of Clogher, visited this part of the world about the year 1723, he expressed the greatest desire to have the matter concerning this written mountain or mountains ascertained, and even made an offer of L. 500 Sterling to any literary person who would undertake the journey and endeavour to decypher the inscriptions; but no such person has appeared, and the existence of the mountains is testified only by the superior of a convent at Cairo, who gave that mentioned in the beginning of this article. Until that part of the world, therefore, become more accessible to travellers, there is but little hope that we can come to any certainty in the matter. M. Niebuhr plainly, from his own accounts, had not influence enough with the Arabs to show him almost any thing, as they refused to conduct him even to the summit of Mount Sinai. Mountain.

White Mountains. See *New Hampshire.*

Mountains of the Moon, a chain of mountains in Africa, extending themselves between Abyssinia and Monomotapa, and receiving the above denomination from their great height.

Mountains of the Lions, also in Africa, divide Nigritia from Guinea, and extend as far as Ethiopia. They were styled by the ancients *the mountains of God*, on account of their being greatly subject to thunder and lightning.

Mountain of Forty-days; a mountain of Judea, situated in the plain of Jericho to the north of that city. According to the Abbe Mariti's description, the summit of it is covered neither with shrubs, turf, nor earth; it consists of a solid mass of white marble, the surface of which is become yellow by the injuries of the air. "The path by which you ascend to it (says our author) fills one with terror, as it rises with a winding course between two abysses, which the eye dares scarcely behold. This path is at first pretty broad, but it at length becomes so confined, that one can with difficulty place both feet upon it at the same time. When we had ascended a little higher, we found an Arab stretched out on the path, who made us pay a certain toll for our passage. Here the traveller requires courage. One of the parapets of the path being broke, we clung to the part which remained until we had reached a small grotto, situated very commodiously, as it gave us an opportunity of recovering our breath. When we had rested ourselves a little, we pursued our course, which became still more dangerous. Suspended almost from the rock, and having before our eyes all the horror of the precipice, we could advance only by dragging one foot after the other; so that had the smallest fragment given way under us, we should have been hurried to the bottom of this frightful abyss.

"Proceeding a little farther, we found a second grotto, the entrance of which was about nine feet in breadth. It would be of considerable size, were not about two-thirds of it filled up by part of the roof, which had tumbled down. This grotto conducts to another, which we had the curiosity to enter, but we were almost stifled by the great number of bats which were fluttering up and down in it. Being desirous of retreating almost as soon as we had entered, they flew in such numbers around us, that they in a manner covered our whole bodies; but they luckily made a passage for themselves, and suffered us to breathe with freedom. By the glimmering light which reached this grotto, we perceived that the bottom of it was covered to the height of a hand-breadth with the excrements of these animals; and we remarked some niches in the sides of it, which gave us reason to conclude, that it had once served as a sepulchre to the ancient anchorets. This is the more probable, as the other grotto appears by the remains of an altar and of some Greek paintings to have been formerly a church. In the right corner there is a large cistern, the plaster of which retains its original solidity, though

Mountain, Mourning. broken in a few places. In the left corner there is a ſmall ſtair which conducts to a third grotto. This is much longer and broader than any of the former, and its walls are ornamented alſo with Greek paintings, which repreſent the twelve apoſtles in their natural ſize. Their figures, however, are ſo much changed, that one could ſcarcely diſtinguiſh who they are, were it not that their names are written in Greek characters upon the glory which ſurrounds their heads — At the farther end of this grotto ſtands a ſquare altar a little damaged; above which is an oval painting of the Annunciation, in perfect preſervation. The chiſel has been employed to render theſe grottos regular and ſmooth; and it appears that they were inhabited by a certain number of hermits, who devoted themſelves to a life of contemplation. No writer has been able to tell us who the founder of this hermitage was.— Nicephorus and Euſebius, who have deſcribed all the churches and religious places of Paleſtine and Judea, do not ſpeak of theſe chapels.

"This mountain is one of the higheſt in the province, and one of its moſt ſacred places. It takes its name from the rigorous faſt which Chriſt obſerved here after having triumphed over the vanities of the world and the power of hell. In remembrance of this miracle, a chapel was formerly conſtructed on the ſummit of the mountain. It may be ſeen from the plain, but we could not approach it, as the path was almoſt entirely deſtroyed. It, however, may be acceſſible on the other ſide of the mountain, which we did not viſit. A great many ſcattered grottos are ſeen here; in one of which, according to Quareſmius, were depoſited the bodies of ſeveral anchorets, which are ſtill entire. I have heard the ſame thing aſſerted in the country, but I could never meet with any perſon who had ſeen them. Here we enjoyed the moſt beautiful proſpect imaginable. This part of the Mountain of Forty Days overlooks the mountains of Arabia, the country of Gilead, the country of the Ammonites, the plains of Moab, the plain of Jericho, the river Jordan, and the whole extent of the Dead Sea. It was here that the devil ſaid to the Son of God, 'All theſe kingdoms will I give thee, if thou wilt fall down and worſhip me."

MOURNING, a particular dreſs or habit worn to ſignify grief on ſome melancholy occaſion, particularly the death of friends or of great public characters — The modes of mourning are various in various countries; as alſo are the colours that obtain for that end. In Europe, the ordinary colour for mourning is black; in China, it is white; in Turkey, blue or violet; in Egypt, yellow; in Ethiopia, brown. White obtained formerly in Caſtile on the death of their princes. Herrera obſerves, that the laſt time it was uſed was in 1498, at the death of prince John. Each people pretend to have their reaſons for the particular colour of their mourning: white is ſuppoſed to denote purity; yellow, that death is the end of human hopes, in regard that leaves when they fall, and flowers when they fade, become yellow: brown denotes the earth, whither the dead return; black, the privation of life, as being the privation of light: blue expreſſes the happineſs which it is hoped the deceaſed does enjoy; and purple or violet, ſorrow on the one ſide, and hope on the other, as being a mixture of black and blue.

Mourning. MOURNING, among the ancients, was expreſſed various ways.

Amongſt the Jews, on the death of their relations or intimate friends, grief or mourning was ſignified by weeping, tearing their clothes, ſmiting their breaſts, or tearing them with their nails, pulling or cutting off their hair and beards, walking ſoftly, *i. e.* bare-foot, lying upon the ground, faſting, or eating upon the ground. They kept themſelves cloſe ſhut up in their houſes, covered their faces, and abſtained from all work, even reading the law, and ſaying their uſual prayers. They neither dreſſed themſelves, nor made their beds, nor ſhaved themſelves, nor cut their nails, nor went into the bath, nor ſaluted any body: ſo that ſulkineſs ſeems to have been an indication of ſorrow; and dirtineſs, of diſtreſs. The time of mourning among the Jews was generally ſeven days: tho' this was lengthened or ſhortened according to circumſtances; but 30 days were thought ſufficient upon the ſevereſt occaſions. The different periods of the time of mourning required different degrees of grief, and different tokens of it.

The Greeks, on the death of friends, ſhowed their ſorrow by ſecluding themſelves from all gaiety, entertainments, games, public ſolemnities, the enjoyment of wine, and the delights of muſic. They ſat in gloomy and ſolitary places, ſtripped themſelves of all external ornaments, put on a coarſe black ſtuff by way of mourning, tore their hair, ſhaved their heads, rolled themſelves in the duſt and mire, ſprinkled aſhes on their heads, ſmote their breaſts with their palms, tore their faces, and frequently cried out with a lamentable voice and drawling tone, reiterating the interjection ε, ε, ε, ε; hence funeral lamentations were called Ελεγοι. If they appeared in public during the time of mourning, they had a veil thrown over their faces and heads. During the funeral proceſſion, certain perſons called εξαρχοι θρηνων marched before, and ſung melancholy ſtrains called ογοφυγμοι ιαλεμοι, Αινοι and Αιλινοι. Theſe vocal mourners ſung thrice during the proceſſion round the pile and round the grave. Flutes were alſo uſed to heighten the ſolemnity. At the funerals of ſoldiers, their fellow-ſoldiers who attended, as a teſtimony of their affliction held their ſhields, their ſpears, and the reſt of their armour, inverted.

As to the tokens of private grief among the Romans, they were the ſame as thoſe already obſerved as cuſtomary amongſt the Greeks. Black or dark-brown were the colours of the mourning habits worn by the men; they were alſo common to the women. The mourning of the emperors at firſt was black. In the time of Auguſtus, the women wore white veils, and the reſt of their dreſs black. From the time of Domitian they wore nothing but white habits, without any ornaments of gold, jewels, or pearls. The men let their hair and beards grow, and wore no wreaths of flowers on their heads while the days of mourning continued. The longeſt time of mourning was ten months: this was Numa's eſtabliſhment, and took in his whole year. For a widow to marry during this time was infamous. Mourning was not uſed for children who died under three years of age. From this age to ten they mourned as many months as the child was years old. A remarkable victory, or other happy event, occaſioned the ſhortening of the time of mourning:

Mouſe ‖ Mouſul.

ing: The birth of a child, or the attainment of any remarkable honour in the family, certain feaſts in honour of the gods, or the conſecration of a temple, had the ſame effect. After the battle at Cannæ, the commonwealth decreed that mourning ſhould not be worn for more than 30 days, that the loſs might be forgot as ſoon as poſſible. When public magiſtrates died, or perſons of great note, alſo when any remarkable calamity happened, all public meetings were intermitted, the ſchools of exerciſe, baths, ſhops, temples, and all places of concourſe, were ſhut up, and the whole city put on a face of ſorrow; the ſenators laid aſide the *laticlave*, and the conſuls ſat in a lower ſeat than ordinary. This was the cuſtom of Athens alſo, and was obſerved upon the death of Socrates not long after he had been ſentenced to death by their judges.

Præficæ, or mourning women, (by the Greeks called θρηνων ἐξαρχοι), went about the ſtreets: this was cuſtomary among the Jews as well as the Greeks and Romans, (Jerem. ix. 17.)

MOUSE, in zoology. See Mus.

Mouse-Ear, in botany. See Hieracium.

Mouse-Tail. See Myosurus.

Dor-Mouse. See Myoxus.

Shrew-Mouse. See Sorex.

MOUSELLE, the name of an Eaſt Indian tree, with white tubular flowers, which fall off every day in great plenty. They are of a ſweet agreeable ſmell, and the Gentoos are very fond of wearing them, ſtringing and hanging them about their necks and arms. The fruit is a pale-red cherry, of the ſhape and ſize of our white heart-cherry, but the foot-ſtalk is not quite ſo long. This fruit has a ſtone in it, containing a bitter oily kernel. The Indians rub with this oil any part ſtung by a ſcorpion or bitten by a centipede, which it ſoon cures. The crows are very fond of the fruit.

MOUSUL, or Mosul, a large city of Turkey in Aſia, and capital of a Beglerbegate, ſtands on the weſt bank of the Tigris, in the latitude, according to Mr Ives's obſervation, of 36° 30'. It is ſurrounded with ſtone-walls, but has many of its ſtreets lying waſte. Tavernier ſpeaks of it as a ruined place, with only two blind markets and a ſorry caſtle; yet, he ſays, that it is much frequented by merchants, and that its baſha commands 3000 men. There is a bridge of boats over the Tigris; and the city is a thoroughfare from Perſia to Syria, which makes it a place of trade, and which is more augmented by a conſtant traffic from this place to Bagdad. The country on this ſide the river is ſandy and barren; but over againſt it is exceedingly fruitful, and yields very good crops of corn and fruit in abundance. Mr Ives ſays, it was the beſt built city he had ſeen in Turkey; but had nothing in it to attract the notice of an European. It was beſieged for near ſix months by Nadir Shah without ſucceſs. Breaches were frequently made in the walls, and aſſaults continued for three days ſucceſſively; but the aſſailants were conſtantly repulſed, and the breaches made in the day-time repaired during the night. The beſieged had unanimouſly reſolved to die rather than to ſubmit. The Turks declared, that ſhould the place be forced to ſurrender, they were determined to put to death all their wives and daughters firſt, that they might not fall into the vile hands of the abhorred Perſians. The place was therefore defended with uncommon bravery; even the women and children exerted themſelves with the greateſt alacrity. The Chriſtians behaved in ſuch a manner as to gain the eſteem and admiration of the other inhabitants; and ſome of their churches being demoliſhed, they were afterwards repaired at the expence of government.

Mouſul, Mou-tan.

In this city there are a great many moſques, the largeſt and moſt ſtately of which is ornamented on the top with green tiles. At the doors of theſe houſes there are uſually inſcriptions in gilt letters, declaring the awfulneſs of the building, as being the houſe of God. One of them has a minaret which bends like thoſe of Bagdad. Some of the moſt bigotted Turks ſay, that Mahomet ſaluted this minaret as he paſſed; on which it bent its head in reverence to the prophet, and ever after continued in that ſituation. The manufacture of this city is *muſſolen* (muſlin), which is made very ſtrong and pretty fine. In the year 1757 this city and the country adjacent was viſited by a dreadful famine, owing to the preceding hard winter, and innumerable multitudes of locuſts, by which the fruits of the earth were deſtroyed. When Mr Ives was there in 1758, the country was comparatively depopulated. Almoſt all the brute creation had been deſtroyed for the ſubſiſtence of man. During the famine, the people had eaten dogs, and every kind of animal which is held in abhorrence at any other time, not ſparing even their own children; and the dead bodies lay in the ſtreets for want of people to bury them. Their fruit-trees were alſo deſtroyed by the froſt; ſo that when our author was there ſcarce any fruit could be had. The neighbouring mountains afford ſilver mines; and they would yield much quickſilver if the Turks had either the ſkill or inclination to work them to advantage. Lanza ſays, that ſome time ago an Engliſhman who travelled through theſe parts got two or three bottles of it, which he preſented to the baſha as a ſpecimen of what might be done in that way: but no farther attempt was made. Here alſo are ſome lead mines, which ſupply as much of that metal as furniſhes them with bullets and ſome neceſſary utenſils.

MOU-TAN, or peony-shrub of China: alſo called *hoa-ouang*, or "the king of flowers;" and *peleang-kin*, "an hundred ounces of gold," in alluſion to the exceſſive price given formerly by ſome of the virtuoſi for certain ſpecies of this plant. The mou-tan ſeems to claim pre-eminence, not only on account of the ſplendor and number of its flowers, and of the ſweet odour which they diffuſe around, but alſo on account of the multitude of leaves which compoſe them, and of the beautiful golden ſpots with which they are interſperſed. This plant, which is of a ſhrubby nature, ſhoots forth a number of branches, which form a top almoſt as large as thoſe of the fineſt orange-trees that are planted in boxes. Some of the mou-tan have been ſeen eight or ten feet in height. The reaſon why few are raiſed at preſent to this ſize is, becauſe their flowers are leſs beautiful, and their branches being too weak, cannot ſuſtain their weight. The root of the mou-tan is long and fibrous, of a pale yellow colour, and covered with a greyiſh or reddiſh rind. Its leaves are deeply indented, and of a much darker green above than below. Its flowers, which are compoſed of numberleſs-

Mou-tan, Mouth.

berleſs petals, blow like a roſe, and are ſupported by a calyx compoſed of four leaves. From the bottoms of the petals ariſe ſeveral ſtamina without any order, which bear on their tops ſmall antheræ, of a beautiful golden colour. The fruit bend downwards like thoſe of common peony, burſt when they become dry, and ſhed their ſeeds.

Groſier's Hiſt. of China.

There are three kinds of mou-tan; common mou-tan, dwarf mou-tan, and the mou-tan tree. The laſt ſpecies ſeems at preſent to be loſt; ſome of them were formerly ſeen which were 25 feet in height. Dwarf mou-tan is little eſteemed: a few plants of this kind are only cultivated to preſerve the ſpecies. Common mou-tan, which has always been highly prized by floriſts, is more generally diſperſed. It is raiſed like an eſpalier in form of a fan, buſh, or orange-tree. Some of them flower in ſpring, others in ſummer, and ſome in autumn. Theſe different ſpecies muſt each be cultivated in a different manner.

The vernal and ſummer mou-tan are thoſe that are cultivated in greateſt number; thoſe of autumn require too ſlaviſh an attention during the great heat of the dog-days. The mou-tan of each ſeaſon are divided into ſingle and double; the former are ſubdivided into thoſe of 100 leaves and 1000 leaves; the ſecond have a large calyx filled with ſtamina, that bear on their tops gold-coloured antheræ. Theſe are the only kind that produce ſeed. The flowers of both appear under the different forms of a baſon, pomegranate, marigold, &c. Some of the mou-tan are red, others violet, purple, yellow, white, black, and blue; and theſe colours, varied by as many ſhades, produce a prodigious number of different kinds. We are aſſured, that the Chineſe floriſts have the ſecret of changing the colour of their mou-tan, and of giving them whatever tints they pleaſe; but they cannot effect this change but upon thoſe plants which have never produced flowers.

A mou-tan, to pleaſe the eye of a Chineſe floriſt, muſt have a rough crooked ſtalk, full of knots, and of a blackiſh-green colour; its branches muſt croſs one another, and be twiſted in a thouſand fantaſtical figures; the ſhoots that proceed from them muſt be of a delicate green ſhaded with red; the leaves muſt be large, of a beautiful green, very thick, and ſupported by reddiſh ſtalks; its flowers muſt blow at different times, in form of a tuft, be all of the ſame colour, and ſtand erect upon their ſtems; they muſt alſo be ſeven or eight inches in diameter, and exhale a ſweet and agreeable odour.

MOUTH, in anatomy, a part of the face, conſiſting of the lips, the gums, the inſides of the cheeks, the palate, the ſalival glands, the os hyoides, the uvula, and the tonſils, which ſee under the article ANATOMY.

Mr Derham obſerves, that the mouth in the ſeveral ſpecies of animals is nicely adapted to the uſes of ſuch a part, and well ſized and ſhaped for the formation of ſpeech, the gathering and receiving of food, the catching of prey, &c. In ſome creatures it is wide and large, in others little and narrow; in ſome it is formed with a deep inciſure into the head, for the better catching and holding of prey, and more eaſy comminution of hard, large, and troubleſome food; and in others with a ſhorter inciſure, for the gathering and holding of herbaceous food. In birds it is neatly ſhaped for piercing the air; hard and horny, to ſupply the want of teeth; hooked, in the rapacious kind, to catch and hold their prey; long and ſlender in thoſe that have their food to grope for in mooriſh places; and broad and long in thoſe that ſearch for it in the mud. Nor is the mouth leſs remarkable in inſects; in ſome it is forcipated, to catch, hold, and tear the prey; in others aculeated, to pierce and wound animals, and ſuck their blood; in others, ſtrongly rigid, with jaws and teeth, to gnaw and ſcrape out their food, carry burdens, perforate the earth, nay the hardeſt wood, and even ſtones themſelves, for houſes and neſts for their young.

Mouvans.

MOUVANS (Paul Richard), ſurnamed the *Brave*, a Proteſtant officer, was born at Caſtellane in Provence of a reſpectable family, and made a conſiderable figure in the civil wars of France during the 16th century. His brother, who was likewiſe a Proteſtant, having been killed in a popular tumult excited by the Romiſh prieſts at Draguignan, he took up arms to avenge his death; and, having aſſembled 2000 men, committed great devaſtations in Provence. Being purſued by the Count de Tende at the head of 6000 men, and finding himſelf too weak to keep the field, he took poſt in a convent ſtrongly fortified by nature, and there reſolved to defend himſelf to the laſt extremity. That the war might be terminated amicably, the Count de Tende propoſed an interview; to which Mouvans agreed, on condition that his brother's murderers ſhould be puniſhed, and that thoſe who had taken up arms with him ſhould not be moleſted. Theſe terms being accepted, he diſmiſſed his troops, reſerving only a guard of 50 men for the ſecurity of his perſon. This precaution was not unneceſſary; for the parliament of Aix had received orders from court to puniſh him capitally for being concerned in the conſpiracy of Amboiſe. The baron de la Garde made an attempt to apprehend him; but he was worſted and repulſed with conſiderable loſs. Mouvans at length reſolved to retire to Geneva, where his life would not be in danger; and there he lived for ſome time in tranquillity, nobly rejecting the ſplendid offers made him by the duke of Guiſe if he would join the Catholic party. He returned to France at the recommencement of the troubles, in conſequence of the maſſacre of Vaſſy in 1562, and continued to diſtinguiſh himſelf in the Proteſtant armies. His conduct at Siſterou, where he commanded together with Captain Senas when that city was beſieged by the Count de Sommerive, is particularly deſerving of admiration. After ſuſtaining an aſſault of ſeven hours, in which the beſiegers were repulſed with conſiderable loſs, Mouvans, perceiving that he was too weak to wait a ſecond, determined to abandon the city, and left it during the night with his troops and thoſe of the inhabitants who choſe to accompany him, by a paſs which the enemy had neglected to guard. The number of the inhabitants amounted to 4000 of every age and ſex, men, women, children, and mothers with their infants at their breaſt. This body, in which there was not 1000 men fit to bear arms, directed their courſe towards Grenoble. Muſketeers were placed in the front and rear, while the defenceleſs and unarmed occupied the centre. To add to the difficulty of the march, they were frequently obliged to go out of the way, and to croſs ſteep and

rugged

Mowee ‖ Moyle.

rugged mountains, in order to avoid the ambuſcades which the enemy had laid for them on the road. They ſtopped ſome days to refreſh themſelves in the valleys of Angrone and Pragelas, where they were cordially received and ſupplied with proviſions by the Vaudois. After a march of 21 or 22 days, and being expoſed to the greateſt fatigue and famine, the wretched fugitives at length arrived at Grenoble. The baron des Adrets ſent them under an eſcort to Lyons, where they remained till the treaty of pacification. In 1568 Mouvans was defeated at Méſignae in Perigord, and loſt his life in the engagement. Upon this occaſion he commanded, together with Peter Gourde, the advanced guard of the Proteſtant army. It is alleged, that in deſpair he daſhed out his brains againſt a tree.

MOWEE, one of the Sandwich iſlands diſcovered by Captain Cook, is 162 miles in circumference. A low iſthmus divides it into two circular peninſulas, of which the eaſtern is double the ſize of the weſtern. The mountains in both riſe to an exceeding great height, and may be ſeen at the diſtance of more than 30 leagues. The northern ſhores, like thoſe of Owyhee, afford no ſoundings, and the country preſents the ſame appearance of verdure and fertility. Near the weſt point of the ſmaller peninſula is a ſpacious bay, with a ſandy beach ſhaded with cocoa-nut trees. The country behind has a moſt romantic appearance, the hills riſing almoſt perpendicularly in a great variety of peaked forms; and their ſteep ſides and deep chaſms between them are covered with trees. The tops of theſe hills are entirely bare, and of a reddiſh brown colour. The number of inhabitants are computed at about 65,000. E. Long. 204. 4. N. Lat. 20. 50.

MOXA, or MUGWORT of China; is a ſoft lanuginous ſubſtance, prepared in Japan from the young leaves of a ſpecies of ARTEMISIA, by beating them together when thoroughly dried, and rubbing them betwixt the hands till only the fine fibres are left. The down on the leaves of mullein, cotton, hemp, &c. do as well as moxa.

In the Eaſtern countries it is uſed by burning it on the ſkin: a little cone of the moxa is laid upon the part, previouſly moiſtened, and ſet on fire at the top; it burns down with a temperate glowing heat, and produces a dark coloured ſpot, the exulceration of which is promoted by applying a little garlic; the ulcer is left to diſcharge, or is ſoon healed, according to the intention in uſing the moxa. See ARTEMISIA.

MOYLE (Walter), a learned Engliſh writer in the 18th century, deſcended of a good family in Cornwall, where he was born in 1672. He was ſent to Oxford, and thence removed to the temple; where he applied himſelf chiefly to the general and more noble parts of the law, ſuch as led him to the knowledge of the conſtitution of the Engliſh government. In 1697 he had a ſhare with Mr Trenchard in writing a pamphlet, intitled, "An Argument ſhowing that a Standing Army is inconſiſtent with a Free Government, and abſolutely deſtructive to the Conſtitution of the Engliſh Monarchy." He tranſlated Xenophon's Diſcourſe upon Improving the State of Athens. He was for ſome time member of parliament, in which he always acted an honourable part; applying himſelf to the improvement and regulation of trade, and the employment of the poor, which has ſo near a connection with trade. He afterwards retired to his ſeat at Bake in Cornwall, where he applied himſelf with vigour to his ſtudies, and died in 1721. In 1726, his works were printed at London, in 2 vols 8vo.

Moyra ‖ Mucus.

MOYRA. See MOIRA.

MUCILAGE, in pharmacy, is in general any viſcid or glutinous liquor.

MUCILAGE, alſo imports the liquor which principally ſerves to moiſten the ligaments and cartilages of the articulations, and is ſupplied by the mucilaginous glands.

MUCOR, in botany: A genus of the order of fungi, belonging to the cryptogamia claſs of plants. The fungus has veſicular heads ſupported by foot-ſtalks.—There are 12 ſpecies; the moſt remarkable of which are, 1. The ſpærocephalus, or grey round-headed mucor, growing upon rotten wood, and ſometimes upon decayed plants and moſſes. The ſtalks of this are generally black, about a line in height; bearing each at the top a ſpherical ball about the ſize of a pin's head; its coat or rind is covered with a grey powder, and containing within a black or fuſcous ſpongy down. The coat burſts with a ragged, irregular margin. 2. The lichenoides, or little, black, pin-headed mucor. This ſpecies grows in groups near to each other, in chaſms of the barks of old trees, and upon old park-pales. The ſtalks are black, about two lines in height; bearing each a ſingle head, ſometimes a double or treble one, of the ſize of muſtard or poppy ſeeds, of a roundiſh figure at firſt, but when burſt often flattiſh or truncated, and of a black colour. The internal powdered down is black, with a tinge of green. 3. The mucedo, or common grey mould, grows on bread, fruits, plants, and other ſubſtances in a putrid ſtate. It grows in cluſters; the ſtalks a quarter of an inch high, pellucid, hollow, and cylindrical; ſupporting each a ſingle globular head, at firſt tranſparent, afterwards dark grey; which burſts with elaſtic force, and ejects ſmall round ſeeds diſcoverable by the microſcope. 4. The glaucus, or grey cluſter-headed mould, is found on rotten apples, melons, and other fruits; as alſo upon decayed wood, and the ſtalks of wheat. Theſe are of a pellucid grey colour; the ſtalks generally ſingle, ſupporting a ſpherical ball, which, when magnified, appears to be compounded of numerous, fine, moniliform, necklace-like radii. 5. The cruſtaceus, or fingered mould, is frequent upon corrupted food of various kinds. It is of a white aqueous colour; the ſtalks ſingle, each ſupporting at the top four or five necklace-like radii, diverging from the ſame point or centre. 6. The ſepticus, or yellow frothy mucor, is found on the leaves of plants, ſuch as ivy and beech, &c. ſometimes upon dry ſticks, and frequently upon the tan or bark in hot-houſes. It is of no certain ſize or figure, but of a fine yellow colour, and a ſubſtance reſembling at firſt cream beat up into froth. In the ſpace of 24 hours it acquires a thin filmy coat, becomes dry, and full of a ſooty powder adhering to downy threads. The ſeeds under the microſcope appear to be globular. Haller ranks it under a new genus, which he terms *fuligo*; the characters of which are, that the plants contained under it are ſoft, and like butter at firſt, but ſoon change into a black ſooty powder.

MUCUS, a mucilaginous liquor ſecreted by certain glands,

Mucus. glands, and ſerving to lubricate many of the internal cavities of the body. In its natural ſtate it is generally limpid and colourleſs; but, from certain cauſes, will often aſſume a thick conſiſtence and whitiſh colour like pus. As it is ſometimes of very great importance in medicine to diſtinguiſh theſe two fluids from each other, this was lately propoſed as the ſubject of a prize diſputation by the Æſculapian Society of Edinburgh. The prize was gained by Mr Charles Darwin ſtudent of medicine from Litchfield. The concluſions drawn from his experiments were,

1. Pus and mucus are both ſoluble in the vitriolic acid, though in very different proportions, pus being by far leaſt ſoluble.

2. The addition of water to either of theſe compounds decompoſes it. The mucus thus ſeparated either ſwims in the mixture or forms large flocculi in it; whereas the pus falls to the bottom, and forms, on agitation, an uniform turbid mixture.

3. Pus is diffuſible through a diluted vitriolic acid, though mucus is not. The ſame alſo occurs with water, or with a ſolution of ſea-ſalt.

4. Nitrous acid diſſolves both pus and mucus. Water added to the ſolution of pus produces a precipitate, and the fluid above becomes clear and green, while water and the ſolution of mucus form a turbid dirty-coloured fluid.

5. Alkaline lixivium diſſolves, though ſometimes with difficulty, mucus, and generally pus.

6. Water precipitates pus from ſuch a mixture, but does not mucus.

7. Where alkaline lixivium does not diſſolve pus, it ſtill diſtinguiſhes it from mucus, as it then prevents its diffuſion through water.

8. Coagulable lymph is neither ſoluble in concentrated nor diluted vitriolic acid.

9. Water produces no change on a ſolution of ſerum in alkaline lixivium, until after long ſtanding, and then only a very ſlight ſediment appears.

10. Corroſive ſublimate coagulates mucus, but does not pus.

From the above experiments it appears, that ſtrong vitriolic acid and water, diluted vitriolic acid, and cauſtic alkaline lixivium and water, will ſerve to diſtinguiſh pus from mucus; that the vitriolic acid can ſeparate it from coagulable lymph, and alkaline lixivium from ſerum.

Hence, when a perſon has any expectorated matter, the decompoſition of which he wiſhes to aſcertain, let him diſſolve it in vitriolic acid, and in cauſtic alkaline lixivium; and let him add pure water to both ſolutions. If there be a fair precipitation in each, he may be aſſured that ſome pus is preſent. But if there be a precipitation in neither, it is a certain teſt that the mixture is entirely mucus. If the matter cannot be made to diſſolve in alkaline lixivium by time and trituration, we have alſo reaſon to believe that it is pus.

MUCK, or RUNNING A MUCK, is a practice that has prevailed time immemorial in Batavia. To run a muck, in the original ſenſe of the word, is to get intoxicated with opium, and then ruſh into the ſtreet with a drawn weapon, and kill any one that comes in the way, till the party is himſelf either killed or taken priſoner. If the officer takes one of theſe *amocks* or *mohawks* (as they have been called by an eaſy corruption) alive, he has a conſiderable reward; and the unhappy wretches are always broken alive on the wheel: but ſuch is the fury of their deſperation, that three out of four are neceſſarily deſtroyed in attempting to ſecure them.

Mud ‖ Mugil.

MUD-IGUANA. See MURÆNA.

MUFFLE, in chemiſtry, a veſſel much uſed in ſome metallurgic operations. In figure it repreſents an oblong arch or vault, the hinder part of which is cloſed by a ſemicircular plane, and the lower part or floor of which is a rectangular plane. It is a little oven that is placed horizontally in aſſay and enamelling furnaces, ſo that its open ſide correſponds with the door of the fire-place of the furnace. Under this arched oven ſmall cupels or crucibles are placed; and the ſubſtances contained are thus expoſed to heat without contact of fuel, ſmoke, or aſhes.

MUFTI, the chief of the eccleſiaſtical order, or primate of the muſſulman religion. The authority of the mufti is very great in the Ottoman empire; for even the ſultan himſelf, if he would preſerve any appearance of religion, cannot, without hearing his opinion, put any perſon to death, or ſo much as inflict any corporal puniſhment. In all actions, eſpecially criminal ones, his opinion is required, by giving him a writing in which the caſe is ſtated under feigned names; which he ſubſcribes with the words, *He ſhall*, or *Shall not be, puniſhed*. Such outward honour is paid to the mufti, that the grand ſignior himſelf riſes up to him, and advances ſeven ſteps to meet him when he comes into his preſence. He alone has the honour of kiſſing the ſultan's left ſhoulder, whilſt the prime vizier kiſſes only the hem of his garment. When the grand ſignior addreſſes any writing to the mufti, he gives him the following titles: *To the eſad, the wiſeſt of the wiſe, inſtructed in all knowledge, the moſt excellent of excellents, abſtaining from things unlawful, the ſpring of virtue and of true ſcience, heir of the prophetic doctrines, reſolver of the problems of faith, revealer of the orthodox articles, key of the treaſures of truth, the light to the doubtful allegories, ſtrengthened with the grace of the ſupreme Legiſlator of mankind, may the Moſt High God perpetuate thy virtues!* The election of the mufti is ſolely in the grand ſignior, who preſents him with a veſt of rich ſables, &c. If he is convicted of treaſon, or any great crime, he is put into a mortar kept for that purpoſe in the Seven Towers at Conſtantinople, and pounded to death.

MUGGLETONIANS, a religious ſect which aroſe in England about the year 1657; ſo denominated from their leader Lodowick Muggleton, a journeyman taylor, who, with his aſſociate Reeves, ſet up for great prophets, pretending, as it is ſaid, to have an abſolute power of ſaving and damning whom they pleaſed; and giving out that they were the two laſt witneſſes of God that ſhould appear before the end of the world.

MUGIL, the MULLET; in ichthyology, a genus of fiſhes belonging to the order of abdominales. The lips are membranaceous, the inferior one being carinated inwards; they have no teeth; the branchioſtege membrane has ſeven crooked rays; the opercula are ſmooth and round; and the body is of a whitiſh colour. There are two ſpecies, diſtinguiſhed by the number of rays in the back-fin.

The mullet is juſtly ranked by Ariſtotle among the *piſces littorales*, or thoſe that prefer the ſhores to the full

Mugil
||
Mulberry.

full ſea; they are found in great plenty on ſeveral of the ſandy coaſts of our iſland, and haunt in particular thoſe ſmall bays that have influxes of freſh water. They come in great ſhoals, and keep rooting like hogs in the ſand or mud, leaving their traces in form of large round holes. They are very cunning; and when ſurrounded with a net, the whole ſhoal frequently eſcapes by leaping over it; for when one takes the lead, the others are ſure to follow. This circumſtance is obſerved by Oppian; who alſo informs us, that if theſe fiſhes fail to get over at the firſt leap, they never attempt a ſecond, but lie without motion as if they reſigned themſelves to their fate. Mr Pennant ſays he is uncertain whether this laſt obſervation holds good or not: however, Oppian had good opportunity of examining thoſe fiſh, as they ſometimes ſwarm on the coaſts of the Mediterranean. Near Martegues, in the ſouth of France, abundance of mullets are taken in weres made of reeds placed in the ſhallows. Of the milts of the males, which are there called *alletants*, and of the roes of females, which are called *botar*, is made botargo. The materials are taken out entire, covered with ſalt for four or five hours, then preſſed a little between two boards or ſtones, waſhed, and at laſt dried in the ſun for 13 or 14 days.

This fiſh was ſometimes made the inſtrument of a horrible puniſhment for unfortunate gallants. It was uſed both at Athens and Rome; but it is very doubtful whether it was a legal puniſhment or not. By Horace it is mentioned in the following lines:

Diſcincta tunica fugiendum eſt, ac pede nudo;
Ne nummi pereant, aut PYGA, *aut denique fama.*
SAT. II. lib. i. 132.

The mullet is an excellent fiſh for the table, but at preſent not a faſhionable one. The albula * is caught in great quantities about the Bahama iſlands at the times they go in ſhoals to ſpawn; and is there eſteemed very good eating.

* Plate CCCXV.

MUGWORT, in botany; a ſpecies of ARTEMISIA. An infuſion of this plant in white wine, or a bath made of it, has been always eſteemed an emmenagogue, and uſeful in difficult parturition. The leaves, when young and tender, are frequently made uſe of by the Highlanders of Scotland as a pot herb. The country-people in Sweden drink a decoction of them for the ague.

MUID, a large meaſure in uſe among the French, for things dry. The muid is no real veſſel uſed as a meaſure, but an eſtimation of ſeveral other meaſures; as the ſeptier, mine, minot, buſhel, &c.

MUID, is alſo one of the nine caſks, or regular veſſels uſed in France, to put wine and other liquors in. The muid of wine is divided into two demi-muids, four quarter-muids, and eight half-quarter muids, containing 36 ſeptiers.

MULATTO, a name given in the Indies to thoſe who are begotten by a negro man on an Indian woman, or by an Indian man on a negro woman.

MULBERRY, in botany. See MORUS.

MULBERRY-Cyder, a name given by the people of Devonſhire, and ſome other parts of England, to a ſort of cyder rendered very palatable by an admixture of mulberry juice in the making: they chooſe for this purpoſe the ripeſt and blackeſt mulberries, and preſſing out their juice and mixing it with a full-bodied cyder at the time of the grinding and preſſing, give juſt ſo much of it as adds a perceptible flavour. It is very worthy the attention of people who live in other countries, where ſtrong and good cyder is made, that this renders it a ſort of wine much more agreeable than any other Engliſh liquor, and might be brought into general uſe, to the great advantage of the dealer. The colour of this liquor reſembles that of the brighteſt red wine, and the flavour of the mulberry never goes off. Phil. Tranſ. N° 133.

Mulct, Mule.

MULCT, a fine of money laid upon a man who has committed ſome fault or miſdemeanour.

MULE, in zoology, a mongrel kind of quadruped, uſually generated between an aſs and a mare, and ſometimes between a horſe and a ſhe-aſs; but the ſignification of the word is commonly extended to every kind of animal produced by a mixture of two different ſpecies. There are two kinds of theſe animals; one from the he-aſs and mare, the other from the horſe and the ſhe-aſs. We call them indifferently *mules*, but the Romans diſtinguiſhed them by proper appellations. The firſt kind are the beſt and moſt eſteemed; as being larger, ſtronger, and having leaſt of the aſs in their diſpoſition. The largeſt and ſtouteſt aſſes, and the faireſt and fineſt mares, are choſen in thoſe countries where theſe creatures are moſt in uſe; as in Spain, Italy, and Flanders. In the laſt eſpecially, they ſucceeded in having very ſtately mules from the ſize of their mares, ſome of them 16 and ſome 17 hands high, which are very ſerviceable as ſumpter-mules in the army. But ſince the Low Countries are no longer under the dominion of Spain, they breed fewer mules. Theſe creatures are very much commended for their being ſtronger, ſurer footed, going eaſier, being more cheaply maintained, and laſting longer than horſes. They are commonly of a black-brown, or quite black, with that ſhining liſt along the back and croſs the ſhoulders which diſtinguiſhes aſſes. In former times they were much more common in this country than at preſent; being often brought over in the days of Popery by the Italian prelates. They continued longeſt in the ſervice of millers; and are yet in uſe among them in ſome places, on account of the great loads they carry on their back. As they are capable of being trained for riding, bearing burdens, and for draught, there is no doubt that they might be uſefully employed in many different ſervices. But they are commonly found to be vicious, ſtubborn, and obſtinate to a proverb; which whether it occaſions or is produced by the ill uſage they meet with, is a point not eaſily ſettled. Whatever may be the caſe of aſſes, it is allowed that mules are larger, fairer, and more ſerviceable in mild than in warm climates. In the Britiſh American colonies, both on the continent and in the iſlands, but eſpecially in the latter, they are much uſed and eſteemed; ſo that they are frequently ſent to them from hence, ſuffer leſs in the paſſage, and die much ſeldomer than horſes, and commonly yield, when they arrive, no inconſiderable profit.

It has commonly been aſſerted, that animals produced by the mixture of two heterogeneous ſpecies are incapable of generating, and thus perpetuating the monſtrous breed; but this, we are informed by M. Buffon, is now diſcovered to be a miſtake. Ariſtotle, ſays he, tells us, that the mule engenders with the mare, and that the junction produces an animal which the Greeks call *hinnus*, or *ginnus*. He like-

Mule. wiſe remarks, that the ſhe-mule eaſily conceives, but ſeldom brings the fœtus to perfection. But the moſt remarkable and well atteſted inſtance of this fact, is mentioned in a letter read by M. d'Alembert before the academy of ſciences, which informed him that a ſhe-mule in the iſland of St Domingo had brought forth a foal. The fact was atteſted by perſons of the moſt unqueſtionable veracity; and other inſtances, though not ſo well authenticated, are adduced by our author. We may therefore, continues M. Buffon, conſider it as an eſtabliſhed fact, that the he-mule can generate and the ſhe-mule produce. Like other animals, they have a ſeminal liquor, and all the organs neceſſary to generation. But mongrel animals are always leſs fertile and more tardy than thoſe of a pure ſpecies. Beſides, mules have never produced in cold climates, ſeldom in warm regions, and ſtill more ſeldom in temperate countries. Hence their barenneſs, without being abſolute, may be regarded as poſitive; ſince their productions are ſo rare, that a few examples can be only collected.

The tranſlator of Buffon's works, in a note on the paſſage above-quoted, has given a remarkable and well authenticated inſtance of the prolific powers of a ſhe-mule in the north of Scotland. Having heard that a mule, belonging to Mr David Tullo farmer in Auchtertyre, in the county of Forfar, had ſome years ago brought forth a foal, he tranſmitted a few queries to be put to Mr Tullo; and requeſted that his anſwers might be legally atteſted before a magiſtrate. This requeſt was cheerfully complied with; and the following is an exact copy of the queries, anſwers, and atteſtations.

Interrogatories to be put to Mr Tullo tenant in Auchtertyre, pariſh of Newtyle, and county of Forfar, with his anſwers thereto.

1mo, Had you ever a ſhe-mule? At what period? Is it true that the mule had a foal? At what time was ſhe covered; and when did ſhe foal?—Anſwered by Mr Tullo: That he bought a ſhe-mule about 20 years ago: That ſhe was conſtantly in ſeaſon for a horſe: That, about ſome years thereafter, he gave her a horſe; and that ſhe thereafter gave him a foal, about the 10th of June. The mule's price was L. 4, 5 s. Sterling.

2do, What was the colour of the foal? Was there any thing particular in its figure?—Anſwer: The foal was exactly the colour of its mother, inclined to black, with a very large head, big ears, and ſmall tail; and the declarant thinks, had its head been weighed when foaled, it would have weighed nearly as much as its body.

3tio, How long was the animal allowed to live?—Anſwer: The next day after the mule foaled, it was ſent, with its mother, to the Loch of Lundie, in order to let the foal die, as the declarant could not want the mule's work, and the mother ſeemed not fond of the foal: That it was accordingly left, and next day came to Auchtertyre, about two miles diſtance, over a hill, with the cattle of Auchtertyre, that had been grazing near to that place, and was drowned in a ditch the day following.

4to, Was its ſkin preſerved, or the head, or any other bones of the ſkeleton? Could any part thereof be ſtill found?—Anſwered: Neither the ſkin nor any part of the ſkeleton was preſerved, nor can be now had; though the declarant has often regretted the not preſerving the foal, as its mother always performed any work that a horſe of 15 l. value could do. Mule, Mulhauſen.

5to, Is the mother ſtill alive? What is her age?—Anſwer: The mother died about eight years ago, of an epidemic cold that was raging among the horſes in this country: The mule had little or no milk after foaling, and the foal got ſome cow's milk: And this is all that he remembers of the matter. DAVID TULLO.

Auchtertyre, 4th Feb. 1780. We James Small tenant in Burmouth, and Robert Ramſay tenant in Newtyle, hereby certify, That we have often ſeen the mule above-deſcribed; and we know that ſhe had a foal, as is narrated by David Tullo.

JAMES SMALL. ROB. RAMSAY.

Ballantyne houſe, 4th Feb. 1780. The within interrogatories were put to David Tullo tenant in Auchtertyre, anent the mule he had, and the foal ſhe produced; to which he gave the anſwers ſubjoined to each query, and ſigned them; as did James Small and Robert Ramſay, atteſting the truth thereof, in preſence of GEORGE WATSON, J. P.

The original atteſtation is in the poſſeſſion of the tranſlator; and he lately tranſmitted notorial or authenticated copies of it to the count de Buffon, and to Thomas Pennant, Eſq; of Downing, in Flintſhire.

MULES, among gardeners, denote a ſort of vegetable monſters produced by putting the farina fœcundans of one ſpecies of plant into the piſtil or utricle of another.

The carnation and ſweet-william being ſomewhat alike in their parts, particularly their flowers, the farina of the one will impregnate the other, and the ſeed ſo enlivened will produce a plant differing from either. An inſtance of this we firſt had in Mr Fairchild's garden at Hoxton; where a plant is ſeen neither ſweet-william nor carnation, but reſembling both equally: this was raiſed from the ſeed of a carnation that had been impregnated by the farina of the ſweet-william. Theſe couplings being not unlike thoſe of the mare with the aſs, which produce the mule, the ſame name is given them; and they are, like the others, incapable of multiplying their ſpecies.

This furniſhes a hint for altering the property and taſte of any fruit, by impregnating one tree with the farina of another of the ſame claſs; *e. gr.* a codlin with a pear-main, which will occaſion the codlin ſo impregnated to laſt a longer time than uſual, and to be of a ſharper taſte. Or if the winter-fruits be fecundated with the duſt of the ſummer kinds, they will ripen before their uſual time. And from this accidental coupling of the farina of one with another, it may poſſibly be, that an orchard where there is variety of apples, even the fruit gathered from the ſame tree differ in their flavour, and in the ſeaſon of maturity. It is alſo from the ſame accidental coupling that the numberleſs varieties of fruits and flowers raiſed every day from ſeed proceed.

Wild or Fecund MULE. See EQUUS, p. 712.

MULHAUSEN, an imperial and Hanſeatic town of Germany, in Upper Saxony, and in Thuringia, under the protection of the elector of Saxony; ſeated

Mulhauſen || Muller.

in a fertile country, on the river Unſtrutht, 15 miles north eaſt of Eiſenach, and 45 eaſt by ſouth of Caſſel. E. Long. 10. 49. N. Lat. 51. 13.

MULHAUSEN, a conſiderable town of Germany, in Alſace, and capital of a republic in alliance with the Swiſs. It is populous, well built, and adorned with handſome public ſtructures; ſeated in a pleaſant fertile country, on an iſland formed by the river Ill, 15 miles north-weſt of Baſle, and 20 eaſt of Befort. E. Long. 7. 24. N. Lat. 47. 48.

MULIER, in law, ſignifies the lawful iſſue born in wedlock, though begotten before. The mulier is preferred to an elder brother born out of matrimony; as for inſtance, if a man has a ſon by a woman before marriage, which iſſue is a baſtard, and afterwards marries the mother of the baſtard, and they have another ſon, this ſecond ſon is mulier and lawful, and ſhall be heir of the father; but the other can be heir to no perſon*. By the civil law, where a man has iſſue by a woman, if after that he marries her, the iſſue is mulier.

* See the article *Baſtard.*

MULL, one of the Weſtern Iſlands of Scotland, about 25 miles long, and as much in breadth. It is in general rocky and barren, not producing a ſufficient quantity of corn for the inhabitants; but a great number of cattle are annually exported, which with the fiſhings and a conſiderable quantity of kelp are the only articles of commerce. It is deeply indented with bays and creeks, forming in ſeveral parts good natural harbours. There are no villages except Tobermorey, near the northern point of the iſland, where a fiſhing ſtation has been lately erected. The iſland was originally part of the dominions of the Lords of the Iſles; but in after-times it became part of the poſſeſſions of the ancient and valiant family of Macleans, who ſtill retain one-half. The other is the litigated property of the duke of Argyle, whoſe anceſtor poſſeſſed himſelf of it in 1674, on account of a debt; but after the courts of law had made an adjudication in his favour, he was obliged to ſupport their decree by force of arms. The ruins of ſeveral ancient caſtles are ſeen on this iſland.

Mull of Cantyre. See CANTYRE.

Mull of Galloway. See GALLOWAY.

MULLEIN. See VERBASCUM.

MULLER or REGIOMONTANUS (John), a celebrated aſtronomer of the 15th century, was born at Koningſhoven in Franconia in 1436, and acquired great reputation by publiſhing an abridgment of Ptolemy's Almageſt, which had been begun by Purback. He went to Rome to perfect himſelf in the Greek tongue, and to ſee the Cardinal Baſſarion; but finding ſome faults in the Latin tranſlations of George de Trebizond, that tranſlator's ſon aſſaſſinated him in a ſecond journey he made to Rome in 1476, where Pope Sextus IV. had provided for him the archbiſhopric of Ratiſbon, and had ſent for him to reform the calendar. Others ſay that he died of the plague.

MULLER (John), a noted engraver, who flouriſhed about the year 1600, and had been bred under Henry Goltzius, whoſe ſtyle he cloſely imitated. The facility with which he handled the graver (for he worked with that inſtrument only) cannot be ſufficiently expreſſed; his works muſt be ſeen, to convey a proper idea of it to the mind. His engravings are valuable, as productions of a very extraordinary nature; excluſive of which they have a prodigious ſhare of merit. Among his moſt eſtimable performances, may be mentioned, 1. The hand writing on the wall, a middling-ſized plate lengthwiſe, from his own compoſition. 2. The adoration of the wiſe men, the ſame, from the ſame. Fine impreſſions of both theſe prints are very rare. 3. The reſurrection of Lazarus, a large plate lengthwiſe, from Abraham Bloemart. He engraved alſo ſeveral much eſteemed portraits. Muller || Mullus.

MULLER, or *Mullar*, denotes a ſtone flat and even at bottom, but round atop; uſed for grinding of matters on a marble.—The apothecaries uſe mullers to prepare many of their teſtaceous powders; and painters for their colours, either dry or in oil.

MULLER is an inſtrument uſed by the glaſs-grinders; being a piece of wood, to one end whereof is cemented the glaſs to be ground, whether convex in a baſon, or concave in a ſphere or bowl.—The muller is ordinarily about ſix inches long, turned round: the cement they uſe is compoſed of aſhes and pitch. See GRINDING.

MULLERAS, a town of Germany, in the circle of Upper Saxony, and marquiſate of Brandenburg, ſeated 38 miles ſouth of Berlin, upon a canal which joins the Oder and the Spree. This canal is 15 miles in length, 10 yards in breadth, and ſeven feet in depth. It was eight years in making; and ſince that time the cities of Hamburg and Breſlaw have carried on great trade by water. E. Long. 14. 50. N. Lat. 52. 21.

MULLET, in ichthyology. See MUGIL.

MULLET, or *Mollet*, in heraldry, a bearing in form of the rowel of a ſpur, which it originally repreſented.

MULLINGAR, a borough or manor in the county of Weſtmeath, and province of Leinſter, in Ireland, 38 miles from Dublin. It is the ſhire town of that county, and has a barrack for two troops of horſe. It returns two members to parliament; patron the earl of Granard. This is a poſt town. N. Lat. 53. 30. W. Long. 7. 50. Within a few miles of it are the ruins of a church, and alſo thoſe of a caſtle. It is ſituated on the river Feyle. It holds a great wool fair, and is a place of good trade. In 1227, the priory of St Mary, formerly known by the name of *The Houſe of God of Mullingar*, was founded here by Ralph de Petyt biſhop of Meath, for regular canons of the order of St Auguſtin. A Dominican friary was alſo founded here in 1237 by the family of Nugent; ſome ruins of which ſtill remain. In 1622, the friars of Multifarnham began to erect a houſe here for friars of the order of St Francis, but it was never completed. Fairs are held here 6th April, 4th and 5th July, 29th Auguſt, and 11th November.

MULLUS, the SURMULLET, in ichthyology, a genus of fiſhes belonging to the order of thoracici. See Plate CCCXV. This fiſh was highly eſteemed by the Romans, and bore an exceeding high price. The capricious epicures of Horace's days valued it in proportion to its ſize; not that the larger were more delicious, but that they were more difficult to be got. The price that was given for one in the time of Juvenal

Mules || Multiplying.

venal and Pliny is a ſtriking evidence of the luxury and extravagance of the age:

Mullum *ſex millibus emit*
Æquantem ſane paribus ſeſtertia libris *. Juv. Sat. IV.
The laviſh ſlave
Six thouſand pieces for a mullet gave,
A ſeſterce for each pound. Dryden.

* L. 48, 8 s. 9 d.

Pennant. But Aſinius Celer, a man of conſular dignity, gave a ſtill more unconſcionable ſum; for he did not ſcruple beſtowing 8000 *nummi*, or 64 l. 11 s. 8 d. for a fiſh of ſo ſmall a ſize as the mullet: for, according to Horace, a *mullus trilibris*, or one of three lb. was a great rarity; ſo that Juvenal's ſpark muſt have had a great bargain in comparion of what Celer had. But Seneca ſays, that it was not worth a farthing except it died in the very hand of your gueſt; that ſuch was the luxury of the times, that there were ſtews even in the eating-rooms, ſo that the fiſh could at once be brought from under the table, and placed on it; and that they put the mullets in tranſparent vaſes, that they might be entertained with the various changes of its rich colour while it lay expiring. Apicius, a wonderful genius for luxurious inventions, firſt hit upon the method of ſuffocating them in the exquiſite Carthaginian pickle, and afterwards procured a rich ſauce from their livers. — This is the ſame gentleman whom Pliny, in another place, honours with the title of *Nepotum omnium altiſſimus gurges*; an expreſſion too forcible to be rendered in our language. The body of this fiſh is very thick, and covered with large ſcales; beneath them the colour is a moſt beautiful roſy red, the changes of which under the thin ſcales gave that entertainment to the Roman epicures as above-mentioned: the ſcales on the back and ſides are of a dirty orange; thoſe on the noſe a bright yellow; the tail a reddiſh yellow.

MULTIPLE, in arithmetic, a number which comprehends ſome other ſeveral times: thus 6 is a multiple of 2, and 12 is a multiple of 6, 4, and 3; comprehending the firſt twice, the ſecond thrice, &c.

Action of MULTIPLEPOINDING, in Scots law. See Law, n° clxxxiii. 24.

MULTIPLICAND, in arithmetic, the number to be multiplied by another. See Arithmetic.

MULTIPLICATION, in general, the act of increaſing the number of any thing.

Multiplication, in arithmetic, is a rule by which any given number may be ſpeedily increaſed, according to any propoſed number of times. See Arithmetic.

Multiplication, in algebra. See Algebra, p. 401.

MULTIPLICATOR, or Multiplier, in arithmetic, the number by which any other is multiplied, or the number of times it is ſuppoſed to be taken.

MULTIPLICATUS flos, a luxuriant flower, whoſe petals are multiplied ſo as to exclude a part of the ſtamina.

A multiplied luxuriant flower differs from a full one, the higheſt degree of luxuriance, in that the petals of the latter are ſo multiplied as to exclude all the ſtamina: whereas thoſe of the former are only repeated or multiplied, two, three, or four times, as to the excluſion of only a ſmall part of the eſſential organs.

MULTIPLYING-glass, in optics, a glaſs wherewith objects appear increaſed in number. See (the *Index* ſubjoined to) Optics.

MULTURE, in Scots law, a certain ſtipulated quantity of meal given as payment to the proprietor or tackſman of a mill for grinding the corn; and all corn ground on farms thirled to the mill is obliged to pay multure whether the corn be ground at that mill or elſewhere. Multure || Mummy.

MULVIA, a river of Barbary in Africa, which riſes in the mountains of Atlas, and divides the empire of Morocco from that of Algiers, and then falls into the Mediterranean, to the weſtward of Marſalquiver.

MUM, a kind of malt-liquor much drank in Germany, and chiefly brought from Brunſwick, which is the place of moſt note for making it. The proceſs of brewing mum, as recorded in the town-houſe of that city, is as follows. Take 63 gallons of water that has been boiled till one-third part is conſumed, and brew it with ſeven buſhels of wheaten malt, one buſhel of oat-meal, and one buſhel of ground beans. When it is tunned, the hogſhead muſt not be filled too full at firſt: as ſoon as it begins to work, put into it three pounds of the inner rind of fir, one pound of the tops of fir and beech, three handfuls of carduus benedictus, a handful or two of the flower of roſa ſolis: add burnet, betony, marjoram, avens, pennyroyal, and wild thyme, of each an handful and an half; of elder-flowers, two handfuls or more; ſeeds of cardamum bruiſed, 30 ounces; barberries bruiſed, one ounce: when the liquor has worked a while, put the herbs and ſeeds into the veſſel; and, after they are added, let it work over as little as poſſible; then fill it up: laſtly, when it is ſtopped, put into the hogſhead ten new-laid eggs unbroken; ſtop it up cloſe, and uſe it at two years end. The Engliſh brewers inſtead of the inner rind of fir, uſe cardamum, ginger, and ſaſafras; and alſo add elicampane, madder, and red ſanders.

MUMIA. See Pissaphaltum.

MUMMIUS (L.), a Roman conſul ſent againſt the Achæans, whom he conquered B. C. 147. He deſtroyed Corinth, Thebes, and Chalcis, by order of the ſenate, and obtained the ſurname of *Achaicus* from his victories. He did not enrich himſelf with the ſpoils of the enemy, but returned home without any increaſe of fortune. He was ſo unacquainted with the value of the paintings and works of the moſt celebrated artiſts of Greece which were found in the plunder of Corinth, that he ſaid to thoſe who conveyed them to Rome, that if they loſt them or injured them, they ſhould make others in their ſtead.

MUMMY, a body embalmed or dried, in the manner uſed by the ancient Egyptians; or the compoſition with which it is embalmed. There are two kinds of bodies denominated *mummies*. The firſt are only carcaſes dried by the heat of the ſun, and by that means kept from putrefaction: theſe are frequently found in the ſands of Libya. Some imagine, that theſe are the bodies of deceaſed people buried there on purpoſe to keep them entire without embalming; others think they are the carcaſes of travellers who have been overwhelmed by the clouds of ſand raiſed by the hurricanes frequent in thoſe deſarts. The ſecond kind of mummies are bodies taken out of the catacombs near Cairo, in which the Egyptians depoſited their dead after embalming. See Embalming.

Mummy.

We have two different ſubſtances preſerved for medicinal uſe under the name of *mummy*, though both in ſome degree of the ſame origin. The one is the dried and preſerved fleſh of human bodies, embalmed with myrrh and ſpices; the other is the liquor running from ſuch mummies, when newly prepared, or when affected by great heat or damps. The latter is ſometimes in a liquid, ſometimes of a ſolid form, as it is preſerved in vials well ſtopped, or ſuffered to dry and harden in the air. The firſt kind of mummy is brought to us in large pieces, of a lax and friable texture, light and ſpungy, of a blackiſh brown colour, and often damp and clammy on the ſurface: it is of a ſtrong but diſagreeable ſmell. The ſecond kind of mummy, in its liquid ſtate, is a thick, opaque, and viſcous fluid, of a blackiſh colour, but not diſagreeable ſmell. In its indurated ſtate, it is a dry ſolid ſubſtance, of a fine ſhining black colour, and cloſe texture, eaſily broken, and of a good ſmell; very inflammable, and yielding a ſcent of myrrh and aromatic ingredients while burning. This, if we cannot be content without medicines from our own bodies, ought to be the mummy uſed in the ſhops; but it is very ſcarce and dear; while the other is ſo cheap, that it will always be moſt in uſe.

All theſe kinds of mummies are brought from Egypt. But we are not to imagine, that any body breaks up the real Egyptian mummies, to ſell them in pieces to the druggiſts, as they make a much better market of them in Europe whole, when they can contrive to get them. What our druggiſts are ſupplied with, is the fleſh of executed criminals, or of any other bodies the Jews can get, who fill them with the common bitumen, ſo plentiful in that part of the world; and adding a little aloes, and two or three other cheap ingredients, ſend them to be baked in an oven, till the juices are exhaled, and the embalming matter has penetrated ſo thoroughly that the fleſh will keep and bear tranſporting into Europe. Mummy has been eſteemed reſolvent and balſamic: but whatever virtues have been attributed to it, ſeem to be ſuch as depend more upon the ingredients uſed in preparing the fleſh than in the fleſh itſelf; and it would ſurely be better to give thoſe ingredients without ſo ſhocking an addition.

There are found in Poland a kind of natural mummies, or human bodies preſerved without the aſſiſtance of art. Theſe lie in conſiderable numbers in ſome of the vaſt caverns in that country. They are dried with the fleſh and ſkin ſhrunk up almoſt cloſe to the bones, and are of a blackiſh colour. In the wars which ſeveral ages ago laid waſte that country, it was common for parties of the weaker ſide to retire into theſe caves, where their enemies, if they found them out, ſuffocated them by burning ſtraw, &c. at the mouth of the cavern, and then left the bodies; which, being out of the way of injuries from common accidents, have lain there ever ſince.

Mineral MUMMY. See PISSAPHALTUM.

MUMMY, among gardeners, a kind of wax uſed in grafting and planting the roots of trees, made in the following manner: Take one pound of black pitch, and a quarter of a pound of turpentine; put them together into an earthen pot, and ſet them on fire in the open air, holding ſomething in your hand to cover and quench the mixture in time, which is to be alternately lighted and quenched till all the nitrous and volatile parts be evaporated. To this a little common wax is to be added; and the compoſition is then to be ſet by for uſe.

Mumps, Munda.

MUMPS. See MEDICINE-*Index*.

MUNDA, an ancient town of Spain, in the kingdom of Granada, ſeated on the declivity of a hill, at the bottom of which runs a river. W. Long. 4. 13. N. Lat. 48. 15.

This city was anciently famous for a victory gained by Cæſar over the two ſons of Pompey, who had collected an army in Spain after the defeat of their father at Pharſalia. See *(Hiſtory of)* ROME.

The Pompeys poſted their army adjoining [illegible] on a riſing ground, whereof one ſide was defended by the city of Munda, and the other by a ſmall river which watered the plain, and by a marſh; ſo that the enemy could not attack them but in front. Cæſar likewiſe drew up his troops with great art, and having advanced a little way from his camp, ordered them to halt, expecting the enemy would abandon their advantageous poſt, and come to meet him. But as they did not ſtir, Cæſar made as if he intended to fortify himſelf in that poſt; which induced the young general, who looked upon this as a ſign of fear, to advance into the plain, and attack the enemy before they could ſecure themſelves with any works. Pompey's army was by far the moſt numerous; for it conſiſted of 13 legions, 6000 horſe, and an incredible number of auxiliaries, among whom were all the forces of Bocchus king of Mauritania, commanded by his two ſons, both youths of great valour and bravery. Cæſar had 80 cohorts, three legions, to wit, the third, the fifth, and the tenth, and a body of 8000 horſe. As the enemy drew near, Cæſar betrayed a great deal of uneaſineſs and concern, as if he were doubtful of the ſucceſs, knowing he was to engage men no way inferior in valour and experience to his own, and commanded by officers who had on many occaſions given ſignal proofs of their bravery and conduct. Cneius, the elder of the two brothers, was generally looked upon as an able commander; and Labienus, who had revolted, eſteemed ſcarce inferior to himſelf.

However, the dictator, deſirous to put an end to the civil war, either by his own death or that of his rivals, gave the ſignal for the battle, and fell upon the enemy with his uſual vigour and reſolution. At the firſt onſet, which was dreadful, the auxiliaries on both ſides betook themſelves to flight, leaving the Romans to decide their quarrel by themſelves. Then the legionaries engaged with a fury hardly to be expreſſed; Cæſar's men being encouraged by the hopes of putting an end to all their labours by this battle, and thoſe of Pompey exerting themſelves out of neceſſity and deſpair, ſince moſt of them expected no quarter, as having been formerly pardoned. Never was victory more obſtinately diſputed. Cæſar's men, who had been always uſed to conquer, found themſelves ſo vigorouſly charged by the enemy's legionaries, that they began to give ground; and though they did not turn their backs, yet it was manifeſt that ſhame alone kept them in their poſts. All authors agree, that Cæſar had never been in ſo great danger; and he himſelf, when he came back to his camp, told his friends, that he had often fought for victory, but this was the firſt time he had ever fought for life. Thinking himſelf abandoned

Munda. ed by fortune, which had hitherto favoured him, he had ſome thoughts of ſtabbing himſelf with his own ſword, and by a voluntary death preventing the diſgrace of a defeat: but returning ſoon to himſelf, and concluding it would be more to his reputation to fall by the enemy's hand at the head of his troops, than, in a fit of deſpair, by his own, he diſmounted from his horſe, and ſnatching a buckler from one of his legionaries, he threw himſelf like a man in deſpair into the midſt of the enemy; crying out to his *xxxxx of ooys? not aſhamed to deliver* xxxiers of the tenth legion, animated by the example of their general, fell upon the enemy with freſh vigour, and made a dreadful havock of them. But in ſpite of their utmoſt efforts, Pompey's men ſtill kept their ground, and, though greatly fatigued, returned to the charge with equal vigour. Then the Cæſarians began to deſpair of victory; and the dictator, running through the ranks of his diſheartened legionaries, had much ado to keep them together. The battle had already laſted from the riſing to the ſetting of the ſun, without any conſiderable advantage on either ſide.

At length a mere accident decided the diſpute in favour of the dictator. Bogud, a petty king of Mauritania, had joined Cæſar ſoon after his arrival in Spain, with ſome ſquadrons of Numidian horſe; but, in the very beginning of the battle, being terrified at the ſhouting of the ſoldiers, intermingled with groans, and the claſhing of their arms, he had abandoned his poſt, and retired with the auxiliaries under his command to a riſing ground at a ſmall diſtance from the enemy's camp. There he continued the whole day an idle ſpectator of the battle that was fought in the plain. But towards the evening, partly out of ſhame and partly out of compaſſion for his friend Cæſar, he reſolved to fall upon Pompey's camp; and accordingly flew thither with all the forces he had with him. Labienus, appriſed of his deſign, haſtened after him to the defence of the camp; which Cæſar obſerving, cried to his legionaries, *Courage, fellow ſoldiers! the victory at length is ours; Labienus flies.* This artifice had the deſired effect: Cæſar's men, believing that Labienus was truly fled, made a laſt effort, and charged the wing he commanded ſo briſkly, that after a moſt obſtinate diſpute they put them to flight.

Though the enemy's left wing was thus entirely defeated, the right wing, where the elder Pompey commanded, ſtill kept their ground for ſome time. Pompey diſmounting from his horſe, fought on foot like a private man in the firſt line, till moſt of his legionaries being killed, he was forced to ſave himſelf by flight from falling into the enemy's hands. Part of his troops fled back to their camp, and part took ſhelter in the city of Munda. The camp was immediately attacked, and taken ſword in hand; and as for the city, Cæſar, without loſs of time, drew a line of circumvallation round it. This victory was gained on the 16th of the kalends of April, *i. e.* according to our way of counting, on the 17th day of March, when the Dionyſian feſtival, or the Liberalia, were celebrated at Rome; the very day, as Plutarch obſerves, in which Pompey the Great, four years before, had ſet out for the war. In this action Pompey loſt 30,000 men; among whom were the famous Labienus, Attius Varus, and 3000 Roman knights. Seventeen officers of diſtinction were taken, and all the enemy's eagles and enſigns, together with Pompey's faſces, which he had aſſumed as governor of Spain. On Cæſar's ſide only 1000 men were killed and 500 wounded.

Munde || Munich.

MUNDIC, or MARCASITE. See MARCASITE.

MUNDINGOES, the name of a people who live on the ſides of the river Gambia in Africa. They are of a [illegible] over every year from one of the Cape de Verde iſlands to chriſten and marry.

MUNDUS PATENS, the open world, in Roman antiquity, a ſolemnity performed in a ſmall temple, of a round form like the world, dedicated to *Dis* and the reſt of the infernal gods. This temple was opened but three times in the year, *viz.* the 24th of Auguſt, the 4th of October, and the 7th of November. During theſe days, the Romans believed hell was open; on theſe days therefore they never offered battle, liſted ſoldiers, put out to ſea, or married.

MUNICH, a town of Germany, capital of the whole duchy of Bavaria, and the reſidence of the elector. It ſtands on the Iſer, 70 miles ſouth of Ratiſbon and 214 weſt of Vienna, being one of the moſt pleaſant and populous cities of Germany for its bigneſs. The number of the inhabitants is ſaid to be about 40,000. Having been built at firſt on a ſpot of ground belonging to a convent, it had from thence in German the name of *Munchen*, i. e. *Monk's-town*, and a monk for its arms. The elector's palace here is a very grand ſtructure, conſiſting of ſeveral courts, furniſhed and adorned in the moſt magnificent manner, with tapeſtry, gilding, ſculpture, ſtatues, and paintings. It contains an amazing collection of jewels, antiquities, and curioſities. The great hall is 118 feet long and 52 broad; and the ſtair-caſe leading to it, from top to bottom, of marble and gold. In the hall of antiquities are 354 buſts and ſtatues of jaſper and porphyry, braſs and marble. In this palace alſo is a library, containing a vaſt collection of books, and many valuable manuſcripts, in moſt languages, ancient and modern; and a chamber of rarities, among which is the picture of a bravo or aſſaſſin, who is ſaid to have committed 345 murders with his own hand, and to have been accomplice in or privy to 400 more. The treaſury in the chapel contains alſo a vaſt number of pictures, precious ſtones, medals, veſſels of gold and ſilver, &c. Among other curioſities, here is a cherry-ſtone with 140 heads diſtinctly engraven upon it. The gardens of the palace are alſo very fine, and it is ſaid a ſecret paſſage leads from it to all the churches and convents in the town. There is a great number of other fine buildings in this city, public and private, particularly the riding-houſe, town-houſe, opera-room, the Jeſuits college, the large edifice for tournaments, the churches, convents, fountains, &c. Its manufactures are thoſe of ſilk, particularly velvet, woollen cloths, and tapeſtry; and it has two annual fairs, at which great quantities of ſalt, wine, &c. are ſold. The ſtreets are broad and regular; and moſt of the houſes well built, and painted on the outſide. The market-place is extremely beautiful. Not far from Munich are four other palaces, with fine gardens, belonging to the elector, *viz.* thoſe of Sleiſheim, Nymphenburg, Dauchau, and Starenberg. The firſt and laſt

Munich || Munſter.

laſt are about three leagues from the capital; the ſecond about half a league; and the third about two, at a market town of the ſame name.

MUNICH (Count de), was the favourite of the Czarina Ann, and was concerned in all the events of her reign. Being appointed general of her armies, he [illegible] advantages over the Crim Tartars, beat Azim, and took that city toget[illegible]ment near Choczim of Moldavia. He was afterwards prime miniſter to the Czar Iwan VI. but in a ſhort time after he was accuſed of employing the power which his office conferred on him to gratify his own ambition and private reſentment. The Empreſs Eliſabeth brought him to trial, and he was condemned to loſe his life A. D. 1742. This ſentence was mitigated to baniſhment into Siberia, whither many of the victims of his power had been exiled. He was recalled by Peter III. A. D. 1762, and declared field-marſhal. Upon the death of this prince, the Empreſs Catharine II. appointed him director-general of the ports of the Baltic. He died on the 8th of October 1767, at the age of 84.

MUNICIPAL, in the Roman civil law, an epithet which ſignifies inveſted with the rights and privileges of Roman citizens. See MUNICIPIUM.

MUNICIPAL, among us, is applied to the laws that obtain in any particular city or province. And thoſe are called *municipal officers* who are elected to defend the intereſt of cities, to maintain their right and privileges, and to preſerve order and harmony among the citizens; ſuch as mayors, ſheriffs, conſuls, &c.

MUNICIPES, an appellation given by the Romans to the inhabitants of the *municipia* or municipal cities. See MUNICIPIUM.

MUNICPIUM, in Roman antiquity, a corporation, borough, or enfranchiſed city or town, where the inhabitants enjoyed their own laws and cuſtoms, and at the ſame time were honoured with the privileges of Roman citizens; but then this privilege generally reached no further than the bare title. Some indeed, by particular merit, obtained the liberty of votes, which occaſioned that diſtinction of *municipium ſine ſuffragio*, and *municipium cum ſuffragio*.—The inhabitants of the *municipium ſine ſuffragio* were called barely *Romani*, but thoſe of the *municipium cum ſuffragio* were called *cives Romani*.

The difference between proper citizens of Rome and the inhabitants of the municipium may be thus expreſſed. The proper citizens of Rome were, 1. Regiſtered in the cenſus; 2. Had the right of ſuffrage and of bearing honours; 3. Were aſſeſſed in the poll-tax; 4. Served in the legions; 5. Uſed the Roman laws and religion; 6. Were called *Quirites* and *populus Romanus*: Whereas the municipes enjoyed the three firſt of theſe privileges, but were denied the three laſt.

MUNITION, the proviſions with which a place is furniſhed in order for defence; or that which follows a camp for its ſubſiſtence.

MUNITION Ships, are thoſe that have ſtores on board in order to ſupply a fleet of men of war at ſea. In an engagement, all the munition-ſhips and victuallers attending the fleet take their ſtation in the rear of all the reſt; they are not to engage in the fight, but to attend to ſuch directions as are ſent them by the admiral.

MUNSTER (Sebaſtion), a learned writer, was born at Ingleheim, and became a Cordelier; but having embraced Luther's ſentiments, he quitted that order in 1529, and retired to Heidelberg, and afterwards to Baſil, where he taught with reputation. He was a man of great candour, and void of ambition; and was ſo well ſkilled in geography, the mathematics, and the Hebrew tongue, that he was ſurnamed the *Eſdras* and the *Strabo of Germany*. His Latin [illegible]ſlation of the bible is eſteemed. He was the firſt publiſhed a treatiſe on grammar and lexicon: he alſo works. He died of the plague at Baſil [illegible] ſeveral other aged 63. Munſter.

MUNSTER, in Latin *Monomia*, and in Iriſh *Moun*, the moſt ſoutherly province of Ireland; bounded on the north by Leinſter and Connaught, and on the eaſt, weſt, and ſouth, by the ocean. It contains the counties Cork, Clare, Kerry, Limerick, Tipperary, and Waterford; and 3,289,932 Iriſh plantation acres, 740 pariſhes, 63 baronies, and 26 boroughs. It is about 125 miles long and 120 broad; and its principal town is Cork. Its ancient name was *Mumhan*; and in latter ages it was divided into *Deſmond* or ſouth Munſter, *Ormond* or eaſt Munſter, and *Thomond* or north Munſter. It lies between 51. 15. and 53. 0. N. Lat. and 7. 10. to 10. 40. W. Long.

MUNSTER, a territory of Germany, in the circle of Weſtphalia; bounded on the north by Embden and Oldenburg, on the ſouth by the county of Mark and duchy of Weſtphalia, on the weſt by the county of Bentheim and the United Provinces, and on the eaſt by the biſhoprics of Oſnaburg and Paderborn together with the county of Ravenſberg. It is the largeſt of all the Weſtphalian biſhoprics, being in length about 80 miles, and in breadth from 20 to 60. It is divided into 13 bailiwicks; and though in general but a barren country, has ſome fruitful plains, with woods, and quarries of ſtone. The inhabitants, excepting a few of the nobility and gentry, are all Roman Catholics; though Lutheraniſm had once a conſiderable footing here. The biſhop, who is generally alſo elector of Cologne, has a revenue from hence of about 70,000 pounds, and can maintain 8000 men. In conſequence of an unjuſt cuſtom, unknown in the reſt of the empire, he is heir to all ſtrangers who die in the country without children. In the matricula he is rated at 30 foot and 118 horſe; or 832 florins monthly in lieu of them. His chapter conſiſts of 40 canons, who are all noble.

MUNSTER, a city of Germany, capital of a biſhopric of the ſame name and of all Weſtphalia, ſtands at the conflux of the river Aa with the Ems, in E. Long. 7. 49. N. Lat. 52. 0. It is of a circular form, large, and well fortified both by nature and art. It has a fine citadel called the *Brille*, erected by a biſhop named *Bernard van Galen* in order to awe the burghers. The dean and chapter now elect the biſhop; but till the beginning of the 13th century he was nominated by the emperor. This city has been rendered famous by three remarkable tranſactions. 1. By the peace concluded here in 1648, which put an end to a war of 30 years; occaſioned by the perſecuting ſpirit of bigotted papiſts, who choſe rather to plunge their country into all the calamities of war than allow liberty of conſcience to the Proteſtants. By this peace, however,

Munychia ‖ Muræna.

ever, they conſented, much againſt their inclinations, to grant them a toleration. 2. By the diſorders and diſturbances occaſioned here in 1553, by a parcel of enthuſiaſts, headed by a taylor called *John of Leyden* from the place of his birth, who turned out the magiſtrates, and took poſſeſſion of the city, where they perpetrated the moſt horrid villanies and cruelties. 3. For the noble, though unſucceſsful, efforts it made in defence of its liberties againſt the tyranny and uſurpation of the above-mentioned turbulent and bloody-minded biſhop, Bernard van Galen. In this city are a great number of convents and other religious houſes, many of them ſtately piles, and ſurrounded with beautiful gardens.

MUNYCHIA, or *Munychius Portus*, (anc. geog.), a village and port of Athens, nearer to the city, leſs than, and fortified in the ſame manner with the Piræus, to the eaſt of which it lay, or between it and the promontory Sunium, at the mouth of the Iliſſus. Strabo ſays it was an eminence in form of a peninſula, at the foot of which ſtood three harbours, anciently encompaſſed with a wall, taking within its extent the Piræus and other harbours, full of docks, with the temple of Diana Munychia; taking its name from *Mynichus*, the founder of the temple.

MUNYCHIA, an anniverſary ſolemnity obſerved at Athens, in honour of Diana, on the 16th of the month Munychion. Cakes were offered on the occaſion called ἀμφιφῶντες.

MUNYCHION, the tenth month of the Athenian year, containing 29 days, and anſwering to the latter part of our March and the beginning of April. It was ſo called from the feſtival Munychia, which was obſerved in this month. See MONTH and MUNYCHIA.

MUPHTI. See MUFTI.

MURÆNA, or EEL, in ichthyology; a genus of fiſhes, belonging to the order of apodes. The head is ſmooth; there are ten rays in the membrane of the gills; the eyes are covered with a common ſkin; and the body is cylindrical and ſlimy. There are ſeven ſpecies, diſtinguiſhed by their fins, tails, &c. The moſt remarkable are,

1. The *anguilla*, or common eel, is very frequent in all our freſh waters, ponds, ditches, and rivers: according to Mr Pennant, it is the moſt univerſal of fiſh; yet is ſcarce ever found in the Danube, though very common in the lakes and rivers of Upper Auſtria.

The eel is very ſingular in many things relating to its natural hiſtory, and in ſome reſpects borders on the nature of the reptile tribe. It is known to quit its element, and during night to wander along the meadows, not only in order to change its habitation, but alſo for the ſake of prey, feeding on ſnails as it paſſes along. During winter it beds itſelf deep in the mud, and continues in a ſtate like the ſerpent-kind. It is very impatient of cold, and will eagerly take ſhelter in a wiſp of ſtraw flung into a pond in ſevere weather, which has ſometimes been practiſed as a method of taking them. Albertus affirms, that he has known eels to take ſhelter in a hay-rick; yet all periſhed through exceſs of cold. It has been obſerved in a river of England called the *Nyne*, there is a variety of ſmall eel, with a leſſer head and narrower mouth than the common kind, that is found in cluſters in the bottom of the river, and is called the *bed-eel*: theſe are ſometimes rouſed up by the violent floods, and are never found at that time with meat in their ſtomach.

Muræna.

Eels are extremely voracious, and deſtructive to the fry of others. No fiſh lives ſo long out of water as the eel; and it is ſo extremely tenacious of life, that its parts will move a conſiderable time after they are flayed and cut in pieces. They vary much in their colours, from a ſooty hue to a light olive green; and thoſe which are called *ſilver eels* have their bellies white, and a remarkable clearneſs throughout. Beſides theſe, there is a variety of this fiſh known in the river Thames by the name of *grigs*, and about Oxford by that of *grigs* or *gluts*. Theſe are ſcarce ever ſeen near Oxford in the winter; but appear in ſpring, and bite readily at the hook, which common eels in that neighbourhood will not. They have a larger head, a blunter noſe, thicker ſkin, and leſs fat, than the common ſort; neither are they ſo much eſteemed, nor do they often exceed three or four pounds in weight.—Common eels grow to a large ſize, ſometimes weighing 15 or 20 pounds; but that is extremely rare. Mr Dale indeed, in the Philoſophical Tranſactions, and ſome others, bring inſtances of eels much exceeding that ſize; but Mr Pennant ſuſpects them to have been congers, ſince the enormous fiſh they deſcribe have all been taken at the mouths of the Thames or Medway. The Romans held eels very cheap, probably on account of their likeneſs to ſnakes. On the contrary, the luxurious Sybarites were ſo fond of theſe fiſh, as to exempt from tribute of every kind thoſe perſons who ſold them.

There is ſcarce any animal the generation of which has puzzled the learned more than this. Ariſtotle firſt broached an opinion that eels were of no ſex, nor did propagate their ſpecies like other animals, but were equivocally gendered of the mud; and as wild and abſurd a ſyſtem as this is, there have not been wanting many, even in theſe latter and more enlightened times, who have given into it. But there is now no room to doubt that all animals are produced by the copulation of parents like themſelves; and the finding of eels in new ponds is eaſily accounted for from the above mentioned circumſtance of their migration. Dr Plot, and many others, have given accounts of whole droves of them leaving one ditch or pond to go to another.

Though the learned world at this time generally allows that eels are produced like other animals, by parents of their own kind, yet there remain many doubts about the manner in which the generation is performed. Some allow the eels to be, like the generality of other animals, of different ſexes in the different individuals; and others affirm that they are all hermaphrodites, each having the parts of generation of both ſexes. Rondeletius affirms that they are of both ſexes; and Mr Allan, who has given a very curious paper concerning them in the Philoſophical Tranſactions, is of the ſame opinion; and both ſay, that the parts of the ſexes may be diſcovered on a careful inſpection; and ſome are found to be males, and others females; but theſe parts are, in both ſexes, they ſay, buried in a large quantity of fat; and they are of opinion, that hence proceeded the miſtake of Ariſtotle and his followers, who, not being able to find thoſe parts, concluded that they did not exiſt at all. Among thoſe who allow the eel to be produced, like other animals, from animal-parents which have the ſexes, ſome are of opinion that they are viviparous,

and

Muræna. and others that they are oviparous: but Mr Chartwynd ſeems to have determined this controverſy by obſerving, that if the aperture under the belly of the eel, which looks red in the month of May, be cut open at that time, the young eels will be ſeen to come forth alive after the operation. Mr Lewenhoeck ſays, that he found an uterus in every eel he examined; and therefore concludes, that they are hermaphrodites: and he ſuppoſes that they have no male parts of generation like thoſe of other animals; but that the office of theſe is performed by a liquor analogous to the male ſeed of animals, which is contained in certain glands, ſituated in the inſide of the uterus itſelf.

Eels have ſometimes been met with in recent ponds, made at ſuch a diſtance from any other water that we cannot reaſonably ſuppoſe them to have migrated thither over land. But in theſe caſes there is reaſon to believe, that the ponds have been ſupplied with them by the aquatic fowl of prey, in the ſame manner as vegetation is ſpread by many of the land-birds, either by being dropped, as they carry them to feed their young, or by paſſing quick through their bodies, as is the caſe with herons.

2. The *conger*, or conger-eel, grows to a vaſt ſize. Dr Borlaſe informs us, that they are ſometimes taken near Mount's-bay of 100 lb. weight; and Mr Pennant aſſures us, that he has heard of ſome taken near Scarborough that were 10 feet and a half long, and 18 inches in circumference in the thickeſt part. They differ from the common eel in the following particulars: 1. Their colour in general is more dark. 2. Their eyes much larger in proportion.—3. The irides of a bright ſilvery colour. 4. The lower jaw is rather ſhorter than the upper. 5. The inſide-line is broad, whitiſh, and marked with a row of ſmall ſpots. 6. The edges of the dorſal and anal fins are black. 7. They have more bones than the common eel, eſpecially along the back quite to the head. 8. They grow to a much larger ſize.

Congers are extremely voracious, preying on other fiſh, and on crabs at the time they have loſt their ſhell and are in a ſoft ſtate. They and eels in general are alſo particularly fond of carcaſes of any kind, being frequently found lodged in ſuch as are accidentally taken up.

The conger eels probably generate like the freſh-water ſpecies. Innumerable quantities of what are ſuppoſed to be their fry come up the Severn about the month of April, preceding the ſhads, which it is conjectured migrate into that river to feed on them: they are called *elvers*. They ſwarm during their ſeaſon, and are taken in a kind of ſieve made of hair-cloth fixed to a long pole; the fiſherman ſtanding on the edge of the water during the tide, puts in his net as far as he can reach, and drawing it out again, takes multitudes at every ſweep, and will take as many during one tide as will fill a buſhel. They are dreſſed, and reckoned very delicate.

Theſe fiſh are an article of commerce in Cornwall; numbers are taken on that coaſt, and exported to Spain and Portugal, particularly to Barcelona.—Some are taken by a ſingle hook and line, but (becauſe that way is tedious, and does not anſwer the expence of time and labour) they are chiefly caught by *bulters*, which are ſtrong lines 500 feet long, with 60 hooks, each eight feet aſunder, baited with pilchards or mackarel; the bulters are ſunk to the ground by a ſtone faſtened to them: ſometimes ſuch a number of theſe are tied together as to reach a mile. The fiſhermen are very fearful of a large conger, leſt it ſhould endanger their legs by clinging round them; they therefore kill them as ſoon as poſſible by ſtriking them on the navel. They are afterwards cured in this manner: They are ſlit, and hung on a frame till they dry, having a conſiderable quantity of fat, which it is neceſſary ſhould exſude before they are fit for uſe. It is remarkable that a conger of 100 weight will waſte by drying to 24 lb.; the people therefore prefer the ſmalleſt, poſſibly becauſe they are ſooneſt cured. During the proceſs there is a conſiderable ſtench; and it is ſaid, that in the fiſhing villages the poultry are fed with the maggots that drop from the fiſh. The Portugueſe and Spaniards uſe thoſe dried congers after they have been ground into a powder, to thicken and give a reliſh to their ſoups. They are ſold for about 40 ſhillings the quintal, which weighs 126 lb. A fiſhery of congers, ſays Mr Pennant, would be of great advantage to the inhabitants of the Hebrides. Perhaps they would at firſt undertake it with repugnancy, from their abſurd averſion to the eel kind.

3. The *ſiren*, or mud-iguana, a ſingular animal, firſt obſerved by Dr Garden of Charleſtown, and afterwards deſcribed by Mr Ellis in the Philoſophical Tranſactions for 1766. It has gills, fins, and two feet; and is in length from 31 to 40 inches. It is an inhabitant of South Carolina, where it is found in ſwampy and muddy places, by the ſides of pools, and under the trunks of old trees that hang over the water, and feeds on ſerpents. The feet appear like little arms and hands, each furniſhed with four fingers, and each finger with a claw. "The head is ſomething like an eel, but more compreſſed; the eyes are ſmall, and placed as thoſe of the eel are. This ſmallneſs of the eye beſt ſuits an animal that lives ſo much in mud. The noſtrils are very plainly to be diſtinguiſhed; theſe, with the gills, and remarkable length of the lungs, ſhow it to be a true amphibious animal.—The mouth is ſmall in proportion to the length of the body; but its palate and inſide of the lower jaw are well provided with many rows of pointed teeth: with this proviſion of nature, added to the ſharp exterior bony edges of both the upper and under jaw, the animal ſeems capable of biting and grinding the hardeſt kind of food. The ſkin, which is black and full of ſmall ſcales, reſembles ſhagreen. Theſe ſcales are of different ſizes and ſhapes, according to their ſituation; but all appear ſunk into its gelatinous ſurface: thoſe along the back and belly are of an oblong oval form, and cloſe ſet together; in the other parts they are round, and more diſtinct. Both the parts are mottled with ſmall white ſpots, and have two diſtinct lines compoſed of ſmall white ſtreaks continued along from the feet to the tail. The fin of the tail has no rays, and is no more than an adipoſe membrane like that of the eel."

Dr Garden, in a letter to Mr Ellis, mentions a remarkable property of this animal, which is, that his ſervant endeavouring to kill one of them by daſhing

it

Mural ‖ Muranum. Plate CCCXV.

it againſt the ſtones, it broke into three or four pieces. Linnæus, from the deſcriptions ſent him, made it a new genus named *Syren*, of a new order *Meantes*, of the claſs amphibia. But from this claſs both the order *Meantes* and that of *Nantes* have been lately expunged; and Gmelin has reduced the ſyren to a ſpecies of the preſent genus. Its place here, however, ſeems ſtill of doubtful propriety; as Gmelin himſelf acknowledges in the Preface to his edition of the Syſtema Naturæ. For Campfer, having lately * had an opportunity to diſſect the ſyren, has diſcovered, that on each ſide of the head it is furniſhed with three true gills, ſeparated from each other by membranes having tooth-like appendages; that the mouth is armed with ſtrong and firmly planted teeth; that the heart has only one ventricle; and that the abdomen is filled with very long and capacious inteſtines: From all theſe circumſtances, he concludes, that this animal ought to be conſidered as a fiſh of the order *Branchioſtegi*;—while in other reſpects it is more nearly allied to the genus *Muræna*, of the order *Apodes*; although it differs materially from the other ſpecies of that genus, by having only three notched bones in the gills, and from the pectoral fins being each divided into four finger-like appendages.

* Kerr's Tranſlation.

MURAL, ſomething belonging to a wall; which the Latins call *murus*.

Mural-Crown, among the ancient Romans. See Crown.

Mural-Arch, is a wall, or walled arch, placed exactly in the plane of the meridian, *i. e.* upon the meridian line, for the fixing of a large quadrant, ſextant, or other inſtrument, to obſerve the meridian altitudes, &c. of the heavenly bodies.

Tycho Brahe was the firſt who uſed a mural arch in his obſervations; after him Hevelius, Mr Flamſtead, De la Hire, &c. uſed the ſame means. See Astronomy.

MURALT (N— de), a native of Switzerland, travelled through a great part of Europe with the views of a philoſopher. He publiſhed a collection of *Lettres ſur les François et ſur les Anglois*, 12mo, 2 vols. 1726, which met with great ſucceſs, though they are written in a vague and ſuperficial manner. Some other works which he publiſhed are below mediocrity. He died about the year 1750.

MURANT (Emanuel), a much-admired landſcape painter, was born at Amſterdam in 1622. He had the happineſs to be a diſciple of Philip Wouwermans, from whom he acquired that warmth and brilliancy of colouring, and that exquiſite pencil, which have rendered him deſervedly eminent. His ſubjects were views in Holland, villages, towns, cities, ruins of houſes, and decayed caſtles; all of them exactly ſketched after nature, and ſo exquiſitely finiſhed, that every minute part of a building was perfectly diſcernible, and even every particular ſtone or brick might be counted by the aſſiſtance of a convex glaſs. But this demanded ſo much patience and time, that it was impoſſible for him to paint many pictures; and on that account they are exceedingly ſcarce, and ſold for ſuch prices as muſt place them out of the reach of all ordinary purchaſers. He died in 1700.

MURANUM, (anc. geog.), a town on the confines of Lucania. Now *Morano*; a citadel in the Calabria Citra, at the ſprings of the Sybaris, midway between the Sinus Tarentinus to the eaſt, and the Tuſcan ſea to the weſt. Suppoſed to have ariſen from the ruins of Syphæum, a town of the Bruttii mentioned by Livy.

Muratori, Murcia.

MURATORI (Lewis Anthony), a learned and celebrated Italian writer, born at Vignoles, in the territory of Bologna, in 1672. He early diſcovered an extreme fondneſs for the learned languages and ſciences; and this was ſeconded by an excellent education. After having completed his firſt ſtudies, he embraced the ſtate of an eccleſiaſtic; and applied himſelf to polite literature, philoſophy, theology, civil law, antiquities, and other ſciences; by which means he became in a manner univerſally learned. He was ſcarce 22 years of age when he was made librarian of the Ambroſian library at Milan. In 1700 the duke of Modena, his ſovereign, recalled him, and made him his librarian, and keeper of the archives of his duchy. Muratori diſcharged this double employment during the reſt of his life, and had no other benefice than the provoſtſhip of Santa Maria del Pompoſa. He acquired the eſteem of the learned throughout Europe, who had recourſe to him for the lights they wanted. He became an aſſociate to the Academies of the Arcades of Rome, Della Cruſca, and Colomberia of Florence, the Academy of Etruſca at Cortona, the Royal Society of London, and of the Imperial Academy of Olmutz; and died in 1750. He wrote a great number of learned works; the principal of which are,—1. *Anecdota*, or a collection of pieces taken from the Ambroſian library, 2 vols 4to, with learned notes and diſſertations. 2. A treatiſe on the perfection of the Italian poetry, 2 vols 4to. 3. *Anecdota Græca*, 3 vols 4to. 4. A genealogical hiſtory of the houſe of Modena, 2 vols folio. 5. An excellent collection of the writers of the Italian hiſtory, 27 vols folio, with learned notes. 6. Another collection, under the title of *Antiquitates Italicæ*. 7. A collection of ancient inſcriptions, under the title of *Novus Theſaurus*, 6 vols folio. 8. The annals of Italy, 12 vols 4to, in Italian, &c. 9. Letters, diſſertations, Italian poems, &c.

MURCIA, the Pagan goddeſs of idleneſs.—The name is taken from *murcus* or *murcidus*, an obſolete word, ſignifying a dull, ſlothful, or lazy perſon.—The ſtatues of this goddeſs were always covered with duſt and moſs, to expreſs her idleneſs and negligence. She had a temple in Rome, at the foot of the Aventine mount.

Murcia, a kingdom in Spain, bounded on the north by New Caſtile, on the eaſt by the kingdom of Valencia, on the weſt by Andaluſia and Granada, and on the ſouth by the Mediterranean Sea. It is about 62 miles in length, and 58 in breadth; and its principal river is Segura. The ſoil is dry, becauſe it ſeldom rains, and therefore it produces little corn or wine; but there is plenty of oranges, citrons, lemons, olives, almonds, mulberries, rice, pulſe, and ſugar. It has alſo a great deal of ſilk. It was taken from the Moors in 1265. The air is very healthful.

Murcia, a large, handſome, and populous town of Spain, capital of a kingdom of the ſame name. It is a biſhop's ſee, and contains ſix pariſhes. The cathedral is a moſt ſuperb edifice, with the ſtairs of the ſteeple ſo contrived that a man may ride up to the

Murder. top, either on horſeback or in a coach. It is ſituated in a pleaſant plain, which abounds in fine gardens about the city, in which are the beſt fruits in Spain. It is ſeated on the river Segura, in W. Long. 0. 36. N. Lat. 37. 48.

MURDER, or MURTHER, the act of killing another with violence and injuſtice. The word comes from the Saxon *morth* "death;" which ſome will have to ſignify a violent death; whence the barbarous Latin *murdrum* and *mordrum*.

Among the number of popular errors, is the notion which has obtained, that the dead body would bleed in the preſence or upon the touch of the murderer.

The crime of murder is puniſhed with death in almoſt all nations.

MURDER, or *Murther*, in law, is thus defined, or rather deſcribed, by Sir Edward Coke: "When a perſon, of ſound memory and diſcretion, unlawfully killeth any reaſonable creature in being, and under the king's peace, with malice aforethought, either expreſs or implied." The beſt way of examining the nature of this crime will be by conſidering the ſeveral branches of this definition.

1. It muſt be committed by a perſon *of ſound memory and diſcretion*: for lunatics or infants are incapable of committing any crime; unleſs in ſuch caſes where they ſhow a conſciouſneſs of doing wrong, and of courſe a diſcretion or diſcernment between good and evil.

2. Next, it happens when a perſon of ſuch ſound diſcretion *unlawfully killeth*. The unlawfulneſs ariſes from the killing without warrant or excuſe: and there muſt alſo be an actual killing to conſtitute murther; for a bare aſſault, with intent to kill, is only a great miſdemeſnor, though formerly it was held to be murder. The killing may be by poiſoning, ſtriking, ſtarving, drowning, and a thouſand other forms of death, by which human nature may be overcome. Of theſe the moſt deteſtable of all is poiſon; becauſe it can of all others be the leaſt prevented, either by manhood or forethought. And therefore, by the ſtat. 22 Hen. VIII. c. 9. it was made treaſon, and a more grievous and lingering kind of death was inflicted on it than the common law allowed; namely, *boiling to death*: but this act did not live long, being repealed by 1 Edw. VI. c. 12. There was alſo, by the ancient common law, one ſpecies of killing held to be murder, which may be dubious at this day, as there hath not been an inſtance wherein it has been held to be murder for many ages paſt, viz. bearing falſe witneſs againſt another, with an expreſs premeditated deſign to take away his life, ſo as the innocent perſon be condemned and executed. The Gothic laws puniſhed in this caſe both the judge, the witneſſes, and the proſecutor; and, among the Romans, the *lex Cornelia de ſiccariis*, puniſhed the falſe witneſs with death, as being guilty of a ſpecies of aſſaſſination. And there is no doubt but this is equally murder *in foro conſcientiæ* as killing with a ſword; though the modern law (to avoid the danger of deterring witneſſes from giving evidence upon capital proſecutions, if it muſt be at the peril of their own lives) has not yet puniſhed it as ſuch. If a man, however, does ſuch an act, of which the probable conſequence may be, and eventually is, death; ſuch killing may be murder, although no ſtroke be

Blackſt. Comment.

ſtruck by himſelf, and no killing may be primarily intended: as was the caſe of the unnatural ſon who expoſed his ſick father to the air againſt his will, by reaſon whereof he died; and of the harlot, who laid her child under leaves in an orchard, where a kite ſtruck it, and killed it. So too, if a man hath a beaſt that is uſed to do miſchief; and he, knowing it, *ſuffers* it to go abroad, and it kills a man; even this is manſlaughter in the owner: but if he had purpoſely *turned it looſe*, though barely to frighten people, and make what is called *ſport*, it is with us (as in the Jewiſh law) as much murder as if he had incited a bear or a dog to worry them. If a phyſician or ſurgeon gives his patient a potion or plaſter to cure him, which, contrary to expectation, kills him, this is neither murder nor manſlaughter, but miſadventure; and he ſhall not be puniſhed criminally, however liable he might formerly have been to a civil action for neglect or ignorance: but it hath been holden, that if it be not a *regular* phyſician or ſurgeon who adminiſters the medicine, or performs the operation, it is manſlaughter at the leaſt. Yet Sir Matthew Hale very juſtly queſtions the law of this determination; ſince phyſic and ſalves were in uſe before licenſed phyſicians and ſurgeons: wherefore he treats this doctrine as apocryphal, and fitted only to gratify and flatter licentiates and doctors in phyſic; though it may be of uſe to make people cautious and wary how they meddle too much in ſo dangerous an employment. In order alſo to make the killing murder, it is requiſite that the party die within a year and a day after the ſtroke received, or cauſe of death adminiſtered; in the computation of which the whole day upon which the hurt was done ſhall be reckoned the firſt.

3. Farther: The perſon killed muſt be "*a reaſonable creature in being, and under the king's peace*," at the time of the killing. Therefore to kill an alien, a Jew, or an outlaw, who are all under the king's peace or protection, is as much murder as to kill the moſt regular-born Engliſhman; except he be an alien-enemy, in time of war. To kill a child in its mother's womb, is now no murder, but a great miſpriſion: but if the child be born alive, and dieth by reaſon of the potion or bruiſes it received in the womb, it ſeems, by the better opinion, to be murder in ſuch as adminiſtered or gave them. As to the murder of baſtard-children, ſee BASTARD.

4. Laſtly, the killing muſt be committed "*with malice aforethought*," to make it the crime of murder. This is the grand criterion which now diſtinguiſhes murder from other killing: and this malice prepenſe, *malitia præcogitata*, is not ſo properly ſpite or malevolence to the deceaſed in particular, as any evil deſign in general; the dictate of a wicked, depraved, and malignant heart; *un diſpoſition a faire un male choſe*: and it may be either *expreſs*, or *implied*, in law. Expreſs malice is when one, with a ſedate deliberate mind and formed deſign, doth kill another: which formed deſign is evidenced by external circumſtances diſcovering that inward intention; as lying in wait, antecedent menaces, former grudges, and concerted ſchemes to do him ſome bodily harm. This takes in the caſe of deliberate duelling, where both parties meet avowedly with an intent to murder: thinking it their duty, as gentlemen, and claiming it as their right, to wanton with

Murder. with their own lives and thoſe of their fellow-creatures; without any warrant or authority from any power either divine or human, but in direct contradiction to the laws both of God and man: and therefore the law has juſtly fixed the crime and puniſhment of murder on them, and on their ſeconds alſo. Yet it requires ſuch a degree of paſſive valour to combat the dread of even undeſerved contempt, ariſing from the falſe notions of honour too generally received in Europe, that the ſtrongeſt prohibitions and penalties of the law will never be entirely effectual to eradicate this unhappy cuſtom, till a method be found out of compelling the original aggreſſor to make ſome other ſatisfaction to the affronted party, which the world ſhall eſteem equally reputable as that which is now given at the hazard of the life and fortune, as well of the perſon inſulted, as of him who hath given the inſult. Alſo, if even upon a ſudden provocation one beats another, in a cruel and unuſual manner, ſo that he dies, though he did not intend his death, yet he is guilty of murder by expreſs malice; i. e. by an expreſs evil deſign, the genuine ſenſe of *malitia*. As when a park-keeper tied a boy that was ſtealing wood to a horſe's tail, and dragged him along the park; when a maſter corrected his ſervant with an iron bar, and a ſchoolmaſter ſtamped on his ſcholar's belly, ſo that each of the ſufferers died; theſe were juſtly held to be murders, becauſe the correction being exceſſive, and ſuch as could not proceed but from a bad heart, it was equivalent to a deliberate act of ſlaughter. Neither ſhall he be guilty of a leſs crime who kills another in conſequence of ſuch a wilful act as ſhows him to be an enemy to all mankind in general; as going deliberately, and with an intent to do miſchief, upon a horſe uſed to ſtrike, or coolly diſcharging a gun among a multitude of people. So if a man reſolves to kill the next man he meets, and does kill him, it is murder, although he knew him not; for this is univerſal malice. And if two or more come together to do an unlawful act againſt the king's peace, of which the probable conſequence might be bloodſhed; as to beat a man, to commit a riot, or to rob a park, and one of them kills a man; it is murder in them all, becauſe of the unlawful act, the *malitia præcogitata*, or evil intended beforehand.

Alſo in many caſes where no malice is expreſſed, the law will imply it: as, where a man wilfully poiſons another, in ſuch a deliberate act the law preſumes malice, though no particular enmity can be proved. And if a man kills another ſuddenly, without any, or without a conſiderable provocation, the law implies malice; for no perſon, unleſs of an abandoned heart, would be guilty of ſuch an act upon a ſlight or no apparent cauſe. No affront, by words or geſtures only, is a ſufficient provocation, ſo as to excuſe or extenuate ſuch acts of violence as manifeſtly endanger the life of another. But if the perſon ſo provoked had unfortunately killed the other, by beating him in ſuch a manner as ſhowed only an intent to chaſtiſe and not to kill him, the law ſo far conſiders the provocation of contumelious behaviour, as to adjudge it only manſlaughter, and not murder. In like manner, if one kills an officer of juſtice, either civil or criminal, in the execution of his duty, or any of his aſſiſtants endeavouring to conſerve the peace, or any private perſon endeavouring to ſuppreſs an affray or apprehend a felon, knowing his authority or the intention with which he interpoſes, the law will imply malice, and the killer ſhall be guilty of murder. And if one intends to do another felony, and undeſignedly kills a man, this is alſo murder. Thus if one ſhoots at A and miſſes him, but kills B, this is murder; becauſe of the previous felonious intent, which the law tranſfers from one to the other. The ſame is the caſe, where one lays poiſon for A, and B, againſt whom the priſoner had no malicious intent, takes it, and it kills him, this is likewiſe murder. So alſo, if one gives a woman with child a medicine to procure abortion, and it operates ſo violently as to kill the woman, this is murder in the perſon who gave it. It were endleſs to go through all the caſes of homicide, which have been adjudged, either expreſsly or impliedly, malicious: theſe therefore may ſuffice as a ſpecimen; and we may take it for a general rule, that all homicide is malicious, and of courſe amounts to murder, unleſs where juſtified by the command or permiſſion of the law; excuſed on a principle of accident or ſelf-preſervation; or alleviated into manſlaughter, by being either the involuntary conſequence of ſome act, not ſtrictly lawful, or (if voluntary) occaſioned by ſome ſudden and ſufficiently violent provocation. And all theſe circumſtances of juſtification, excuſe, or alleviation, it is incumbent upon the priſoner to make out, to the ſatisfaction of the court and jury: the latter of whom are to decide whether the circumſtances alleged are proved to have actually exiſted; the former, how far they extend to take away or mitigate the guilt. For all homicide is preſumed to be malicious, until the contrary appeareth upon evidence. Murder.

The puniſhment of murder, and that of man-ſlaughter, were formerly one and the ſame; both having the benefit of clergy: ſo that none but unlearned perſons, who leaſt knew the guilt of it, were put to death for this enormous crime. But now, by ſeveral ſtatutes, the benefit of clergy is taken away from murderers through malice prepenſe, their abettors, procurers, and counſellors. In atrocious caſes it was frequently uſual for the court to direct the murderer, after execution, to be hung upon a gibbet in chains near the place where the fact was committed; but this was no part of the legal judgement; and the like is ſtill ſometimes practiſed in the caſe of notorious thieves. This, being quite contrary to the expreſs command of the Moſaical law, ſeems to have been borrowed from the civil law; which, beſides the terror of the example, gives alſo another reaſon for this practice, viz. that it is a comfortable ſight to the relations and friends of the deceaſed. But now, in England, it is enacted by ſtatute 25 Geo. II. c. 37. that the judge, before whom any perſon is found guilty of wilful murder, ſhall pronounce ſentence immediately after conviction, unleſs he ſees cauſe to poſtpone it; and ſhall in paſſing ſentence direct him to be executed on the next day but one (unleſs the ſame ſhall be Sunday, and then on the Monday following), and that his body be delivered to the ſurgeons to be diſſected and anatomized; and that the judge may direct his body to be afterwards hung in chains, but in nowiſe to be buried without diſſection. And, during the ſhort but awful interval between ſentence and execution, the priſoner

Murderers || Murex.

shall be kept alone, and sustained with only bread and water. But a power is allowed to the judge, upon good and sufficient cause, to respite the execution, and relax the other restraints of this act. See farther, PARRICIDE, and *PETIT Treason.*

MURDERERS, or *Murdering Pieces*, in a ship, are small pieces of ordnance, either of brass or iron, which have chambers put in at their breeches. They are used at the bulk-heads of the fore-castle, half-deck, or steerage, in order to clear the deck, on the ship's being boarded by an enemy.

MURENA. See MURÆNA.

MURENGERS, two officers of great antiquity in the city of Chester, annually chosen out of the aldermen, to see that the walls are kept in repair, and to receive a certain toll and custom for the maintenance thereof.

MURET (Mark Anthony Francis), in Latin *Muretus*, was born at Muret, near Limoges, in 1526. He acquired a perfect knowledge of the Greek and Latin tongues without any instructor, and became one of the most learned men of his time. After having taught some time in Provence, he was made a professor at Paris in the same college with Turnebus and Buchanan. In 1554 he went into Italy; and in 1563 was professor of law, philosophy, and history, at Rome, where he died in 1585. His principal works are, 1. Excellent notes on Terence, Horace, Catullus, Tacitus, Cicero, Sallust, Aristotle, Xenophon, &c. 2. *Orationes.* 3. *Variæ Lectiones, Poemata, Hymni Sacri.* 4. *Disputationes in Lib. I. Pandectorum, de Origine Juris. &c.* 5. *Epistolæ, Juvenilia Carmina, &c.* Most of Muret's works have been printed in the Venice edition of 1737, in 5 vols 8vo.

MUREX, in zoology, a genus of insects belonging to the order of vermes testacea. This animal is of the snail-kind: the shell consists of one spiral valve, rough, with membranaceous furrows; and the aperture terminates in an entire canal, either straight, or somewhat ascending. There are 60 species, particularly distinguished by peculiarities in their shells, &c.

From a species of murex was obtained the famous Tyrian dye so much valued by the ancients. This, however, has long been superseded by the use of the cochineal. One of the shells producing the dye was a kind of buccinum; but the finest, or Tyrian purple, was got from the murex. These species of shells are found in various parts of the Mediterranean. Immense heaps of them are to be seen about Tarentum to this day, evincing one place where this precious liquor was extracted. See Plate CCCXXII.

In the accounts of a Spanish philosopher it is mentioned, that on the coasts of Guayaquil and Guatimala in Peru the murex is also found. The shell which contains it adheres to the rocks that are washed by the sea: it is of the size of a large walnut. The liquor may be extracted two ways: some kill the animal after they have drawn it out of the shell; then press it with a knife from head to tail; separate from the body the part where the liquor is collected, and throw away the rest. When this operation, after being repeated on several snails, has afforded a certain quantity of fluid, the thread intended to be dyed is dipped in it, and the process is finished. The colour, which is at first of the whiteness of milk, becomes afterwards green, and is not purple till the thread is dry. Those who disapprove of this method, draw the fish partly out of the shell, and, squeezing it, make it yield a fluid which serves for dyeing: they repeat this operation four times at different intervals, but always with less success. If they continue it, the fish dies. No colour at present known, says the Abbé Raynal, can be compared to this, either as to lustre, liveliness, or duration. It succeeds better on cotton than wool, linen, or silk.

Murex || Murrain.

MUREX, a caltrap or iron instrument, with sharp points projecting in every direction, used by the Romans as a defence against the enemy's horse. It was so called, probably, because the points bore some resemblance to the spines and tubercles with which the shell of the fish murex is surrounded.

MURGI, or MURGIS (anc. geog.), the last town of Baetica, next the Tarraconensis: the Urce of Ptolemy. Now *Muxara*, a port-town of Granada, on the Mediterranean. W. Long. 1° 50′. N. Lat. 37° 6′.

MURIA, alimentary salt. See SALT.

MURINA, or MURINES, a delicious sweet wine, medicated with spices, and the usual drink of the ladies of antiquity.

MURILLO (Bartholomew-Stephen), a celebrated painter, was born at Pilas near Seville, in 1613. Having shown a very early inclination to painting, he was instructed by his uncle John del Castillo, an artist of some note, whose subjects were fairs and markets; in which style Murillo painted several pictures while he continued with that master: but his principal knowledge in the art was derived from Velasquez, who directed his studies, and frequently retouched his designs. Many writers assert, that he studied at Rome, and improved himself excessively in that city. But Velasco, a Spanish author, affirms that he never was in Italy; but arrived at the excellence he possessed by copying the works of Titian, Rubens, and Vandyck, which were at Madrid, and the Escurial; and also by studying after the antique statues, which are in the Royal collections. However, he became an excellent painter, and was employed by the king of Spain to execute several historical pictures, which raised his reputation through every province of his own country. Those paintings being afterwards sent to Rome as a present to the pope, the Italians were so much pleased with his performances, that they called him a second Paul Veronese. In Spain he designed and finished several grand altar-pieces, for the churches and convents at Madrid, Seville, Cordova, Cadiz, and Granada; and some of his compositions are in the churches of Flanders. But notwithstanding his genius, taste, and abilities, qualified him to execute subjects of history with general applause; yet his favourite subjects were beggar-boys, as large as life, in different actions and amusements; which he usually designed after nature, and gave them a strong and good expression. His original pictures of those subjects have true merit, and are much esteemed, many of them being admitted into the most capital collections of the English nobility; but of those, there are abundance of copies, which, to the dishonour of the artist, are sold as originals to injudicious purchasers. He died in 1685.

MURRAIN, or GARGLE, a contagious disease among cattle. The symptoms are, a hanging down and

Murray. and ſwelling of the head, abundance of gum in the eyes, rattling in the throat, a ſhort breath, palpitation at the heart, ſtaggering, a hot breath, and a ſhining tongue. In order to prevent this diſeaſe, the cattle ſhould ſtand cool in ſummer, and have plenty of good water: all carrion ſhould be ſpeedily buried; and as the feeding of cattle in wet places, on rotten graſs and hay, often occaſions this diſeaſe, dry and ſweet fodder ſhould be given them.

MURRAY, a county of Scotland, extending by the coaſt from the river Spey on the eaſt to Beauly on the weſt, which is the boundary of the province of Roſs. It ſends two members to parliament, and is an earldom in a branch of the Stuart family.

According to the account of the reverend Mr Shaw miniſter of Elgin, in anſwer to ſome queries of Mr Pennant, the country produces wheat, barely, oats, rye, peaſe, and beans. Of theſe, in plentiful years, upwards of 20,000 bolls are exported, beſides ſerving the county itſelf and ſome of the Highland counties. Some hemp is alſo cultivated, and a great deal of flax; of which linen is made, not only for home-conſumption, but a conſiderable quantity of linen-yarn is exported. Great quantities of potatoes are alſo cultivated. Several hundreds of black cattle are alſo exported from the Highlands of Murray, but few or none from the Lowlands.—Peculiar to this province is a kind of wood, called *red ſaugh*, or *ſallow*; which is no leſs beautiful than mahogany. It is much more firm and tough than mahogany, and reſembles the lighter-coloured kind of that wood. It receives a fine poliſh, but is very ſcarce, growing on rocks. But there are great foreſts of firs and birches, which our author thinks are the remains of the Sylva Caledonia. Here alſo is found a remarkable root, called by the natives *carme'e*: it grows in heaths and birch-woods to the bigneſs of a large nut; and ſometimes there are four or five roots joined together by fibres. It has a green ſtalk and ſmall red flowers. Dido, ſpeaking of the Caledonians, ſays, *Certum cibi genus parant ad omnia, quem ſi ceperint quantum eſt unius fabæ magnitudo, minime eſurire aut ſitire ſolent.* Cæſar alſo tells us of a root called *chara*, which his ſoldiers mixed with milk and made into bread when in want of proviſion, which greatly relieved them. This root, Mr Shaw thinks, is the ſame with the *carmele* or *ſweet root* of Murray. He informs us, that he hath often ſeen it dried, and kept for journeys through hills where no proviſion was to be had: he has likewiſe ſeen it pounded and infuſed; the liquor makes a more agreeable and wholeſome liquor than mead. It grows in ſuch plenty, that a cart-load of it can eaſily be gathered.

Murray is interſected by the rivers Spey, Loſſey, Findern, Nairn, Neſs, and Beauly. The river of Spey, riſing on the borders of Lochaber, is more than 60 Scots, or 100 Engliſh miles long, but too rapid to be navigable. Upon this river great floats of fir and birch-wood are carried down to the Frith; the float is guided by a man ſitting on a *courach*. This veſſel is of an oval ſhape, about four feet long and three broad; a ſmall keel from head to ſtern; a few ribs croſs the keel, and a ring of pliable wood round the lip of it; the whole covered with the rough hide of an ox or horſe. The rower ſits on a tranſverſe ſeat in the middle, and holds in his hand a rope, the end of which is tied to the float, and with the other hand he manages a paddle, keeps the float in deep water, and brings it to ſhore when he pleaſes. In this province, alſo, is Loch Neſs, remarkable for its never freezing. There are many other lakes in this country, of which one called *Dundelchack* is remarkable in that it is never covered with ice before the month of January; but after that time one night's ſtrong froſt covers it all over. On the eaſt ſide of Loch Neſs, a large mile above the loch, is the waterfall of Foher, where the river *Feach-Len* falls over a ſteep rock about 80 feet high; and a thick fog riſes from the place where it falls, occaſioned by the violent daſhing of the water. There is a conſiderable ſalmon-fiſhery on the rivers Spey, Findern, Neſs, and Beauly, which ſerves the towns and country, beſides exporting to the value of 12,000l. annually. Murray, Murrhine.

There are many natural caves in the hills of this country, which formerly were the receptacles of thieves and robbers, and now afford ſhelter to hunters and ſhepherds in ſtormy weather. The moſt remarkable mountain is Carngern in Strathſpey. In it are found a particular kind of ſtones well known to the lapidaries. They are of blue, green, yellow, and amber colours; ſome ſo large as to make ſnuff-boxes, or ſmall cups; ſome of hexagonal or pentagonal figures, and tapering to a point at each end. The mountain of Benalar, in Badenoch is by Mr Shaw reckoned to be the higheſt land in Scotland, as waters flowing from it fall into the ſea at Dundee, Inverlochy, and Garmoch in Murray.

MURRHINE, MURRHINUS, Μορρινος, in antiquity, an appellation given to a delicate ſort of ware brought from the eaſt, whereof cups and vaſes were made, which added not a little to the ſplendor of the Roman banquets.

Critics are divided concerning the matter of the pocula, or vaſa murrhina, murrina, or murrea. Some will have them to have been the ſame with our porcelain or china-ware.

The generality hold them to have been made of ſome precious kind of ſtone, which was found chiefly, as Pliny tells us, in Parthia, but more eſpecially in Carmania. Arrian tells us, that there was a great quantity of them made at Dioſpolis in Egypt. This he calls another ſort of murrhina work; and it is evident, from all accounts, that the murrhina of Dioſpolis was a ſort of glaſs-ware, made in imitation of the porcelain or murrha of India. There is ſome difference in the accounts given by Pliny and Martial of the murrhina vaſa. The firſt author ſays, that they would not bear hot liquors, but that only cold ones were drank out of them. The latter, on the other hand, tells us, that they bore hot liquors very well. If we credit Pliny's account, their porcelain was much inferior to our's in this particular. Some conjecture them to have been of agate, others of onyx, others of coral. Baronius, doubtleſs, was fartheſt out of the way, when he took them to be made of myrrh, congealed and hardened. Some have ſuppoſed theſe veſſels to be made of cryſtal; but this is contrary to the account of all the ancients. The Greeks had the words χρυσαλλος for cryſtal, and σμυρνα for myrrh, very common among them; and therefore, if theſe veſſels had been made of either

of

Mus. of theſe ſubſtances, they would in ſome places have called them ſmyrna or cryſtallina. On the contrary, the moſt correct among them call them murrhina or morrina. The cups made of cryſtal, which were alſo in uſe at thoſe times, were called cryſtallina, and theſe murrhina or murrhæa, by way of keeping up the diſtinction; and Martial tells us, that the ſtone they were made of was ſpotted or variegated, calling them pocula maculoſæ murræ. And Statius mentions the cryſtalline and murrhine cups in the ſame ſentence, but as different things, not the ſame. Arrian mentions alſo the λιθος μορρια; which his interpreters cenſure as an error of the copies, and would alter into myrrha, the name of the gum myrrh.

Pompey is recorded as the firſt who brought theſe murrhine veſſels out of the eaſt, which he exhibited in his triumph, and dedicated to Jupiter Capitolinus. But private perſons were not long without them. So fond, in effect, did the Roman gentry grow of them, that a cup which held three ſextaries was ſold for 70 talents. T. Petronius, before his death, to ſpite Nero (or as Pliny expreſſes it, *ut menſam ejus exhæredaret*, to diſinherit his table), broke a baſon, *trulla murrhina*, valued at 300 talents, on which that emperor had ſet his heart.

MUS, in zoology: A genus of quadrupeds belonging to the order of *Glires*; the characters of which are theſe: The upper foreteeth are wedge-ſhaped; there are three grinders, ſometimes (though rarely) only two, on each ſide of the jaws; and the clavicles or collar-bones are complete. In the new edition of the *Syſtema Naturæ*, by Dr Gmelin, the numerous ſpecies of this genus have been diſtributed into different groupes or diviſions, diſtinguiſhed by ſome particular character common to the individuals of each.—The firſt diviſion conſiſts of,

I. Myocastores, or *Beaver-rats*, the individuals of which have the tail *flattened* laterally at the end.

1. The coypus, or webbed beaver-rat, has a thick hairy tail of a moderate length, and the hind-feet webbed. It is an inhabitant of Chili, where it frequents the water. It has a ſtrong reſemblance, both in colour and ſhape, to the otter; but is allied to the murine tribe by the number and arrangement of its teeth.

2. The zibethicus, or muſquaſh, with a long ſharp-pointed tail, and the feet not webbed. This has been already deſcribed under the article Castor, of which it was ranked as a ſpecies in the former editions of Linnæus. In fact, it does reſemble the beaver in the form of the body and flat ſcaly tail, as well as in its manners and economy. In ſize, however, and length of tail, it comes nearer to the brown rat; but in its general appearance, and in the ſhort hairy ears, it reſembles the water-rat.

II. Mures, or *Rats* and *Mice*; having *round* tails, ſome naked and ſome hairy.

1. The piloris, or muſk cavy, with a naked tail blunt at the end, and covered with ſcales. There are two varieties: one with the body of an uniform whitiſh colour; the other with the upper parts tawny, and the under parts white. The former inhabits Ceylon, and the latter the Weſt Indies. They are nearly of the ſize of a rabbit: they both burrow in the ground; ſometimes infeſt houſes like the rat; and have a ſtrong flavour of muſk.

2. The caraco has a naked tail, long, ſcaly, and ſomewhat blunt; the body is of a brown grey colour, and the hind feet are very ſlightly webbed. It inhabits the eaſtern parts of Siberia, and probably Chineſe Tartary and the northern provinces of China; burrowing like the rabbit, near the banks of rivers.—It ſwims remarkably well, and even infeſts houſes.—The body and head are ſix inches in length, and the tail four and a half. Mus. Plate CCCXIX. fig. 10.

3. The americanus, or American rat, has a long, naked, and ſcaly tail; the head is long-ſhaped, with a narrow pointed noſe, the upper jaw being much longer than the lower; the ears are large and naked. It is larger than the black, and ſmaller than the brown rat; its colour is of a deep brown, inclining to aſh on the belly, and the fur is coarſe and harſh. It is probably this ſpecies which is ſaid (Kalm's Trav. ii. 48.) to live among the ſtones and clefts of rocks, in the blue mountains of Virginia, at a diſtance from the peopled part of the country, which comes out only at night, and makes a terrible noiſe.

4. The decumanus, or brown rat, has a long, naked, ſcaly tail; the upper parts of the body are of a light brown, mixed with tawny and aſh colour, the lower parts dirty white. The head and body meaſure about nine inches; and the length of the tail, which conſiſts of 200 rings, is ſeven and a half. The whiſkers are larger than the head; and the eyes are large, black, and prominent. The fore-feet have four toes, with a ſmall claw in place of the fifth or thumb. It inhabits India and Perſia, and has only been known in Europe in the preſent century. They dwell in burrows which they dig in the banks of rivers; and frequent towns, aqueducts, drains, neceſſaries, ſtables, barns, gardens, fields, and houſes. They ſwim and dive with great dexterity; feed on vegetables, grain, fruits, and even deſtroy poultry; and are hunted eagerly by cats, dogs, and ferrets. They lay up ſtores of acorns, beech-maſt, and other proviſions, in their holes; in which the males remain during winter, except in fine weather, without hybernating; but the females and their young live moſtly in barns and out-houſes in that ſeaſon. They often emigrate from one place to another in great companies. The female produces three times in the year, having 12 or 15, even 18 or 19, at a litter. The bite of this creature is not only ſevere but dangerous, the wound being immediately attended with great ſwelling, and is a long time in healing. Theſe animals are ſo bold as to turn upon thoſe who purſue them, and faſten on the ſtick or hand of ſuch as offer to ſtrike them. This ſpecies is ſuppoſed to be the mus caſpicus of Ælian †, which he ſays was nearly as large as the ichneumon, and made periodical viſits in vaſt multitudes to the countries which border on the Caſpian, ſwimming boldly over the rivers, holding by each others tails. Plate CCCXVIII. fig. 5. † *Hiſt.* l. 17. c. 17.

5. The rattus, black or common rat, has an almoſt naked ſcaly tail, which is very ſmall, has 250 diſtinct rings, and is eight inches long. The head and body meaſure ſeven inches in length; the upper parts are deep black grey, and the under parts aſh coloured. There are four toes, and a ſmall claw in place of the fifth, on each fore foot, and five on the hind feet. This ſpecies inhabits India, Perſia, and Europe except its moſt northern parts; from hence it has been carried Fig. 11.

Mus. to Africa and America; and is frequent in Otaheite, though leſs common in the other iſlands of the ſouthern ocean. Of late years it has greatly diminiſhed in Europe, and is even in many places extirpated, in conſequence of the introduction of the brown ſpecies, which deſtroy the black rats; though little is gained by the exchange, the brown having the ſame diſpoſitions, with greater ſtrength and abilities for doing miſchief. It is the moſt pernicious of any of our ſmaller quadrupeds. Meat, corn, paper, cloaths, furniture, in ſhort every convenience of life, is a prey to this deſtructive creature. Nor are its devaſtations confined to theſe: for it will make equal havock among poultry, rabbits, or young game; nay, it has been known to gnaw the extremities of infants when aſleep. It is a domeſtic animal, reſiding very frequently in houſes, barns, or granaries; and it is furniſhed with fore teeth of ſuch ſtrength as enable it to force its way through the hardeſt wood or the oldeſt mortar. It makes a lodge either for its days reſidence, or a neſt for its young, near a chimney; and improves the warmth of it, by forming there a magazine of wool, bits of cloth, hay, or ſtraw. It lodges alſo in cielings, and in the void ſpaces between the wall and the wainſcotting. From theſe lurking-places the rats iſſue in queſt of food, and tranſport thither every ſubſtance they can drag, forming conſiderable magazines, eſpecially when they have young to provide for. The female has ten teats, and brings forth ſeveral times in a year, but always in the ſummer ſeaſon. The litter generally conſiſts of five or ſix; and in ſpite of poiſon, traps, and cats, they thus multiply to ſuch a degree as ſometimes to do a great deal of damage. In old country-houſes where grain is kept, and where the vicinity of barns and magazines facilitates their retreats, they often increaſe ſo prodigiouſly, that the poſſeſſors are obliged to remove and deſert their habitations, unleſs the rats happen to deſtroy each other; an event which frequently takes place, for theſe creatures when pinched for food devour each other. When a famine happens by reaſon of too many being crowded into one place, the ſtrong kill the weak, open their heads, and firſt eat the brain and then the reſt of the body. Next day the war is renewed, and continues in the ſame manner till moſt of them are deſtroyed; which is the reaſon why theſe animals, after being extremely troubleſome for ſome time, diſappear all of a ſudden, and do not return for a long time. Rats are extremely laſcivious; they ſqueak during their amours, and cry when they fight. They ſoon learn their young to eat; and when they begin to iſſue from the hole, their mother watches, defends, and even fights with the cats, in order to ſave them. A large rat is more miſchievous than a young cat, and nearly as ſtrong: the rat uſes her fore-teeth; and the cat makes moſt uſe of her claws; ſo that the latter requires both to be vigorous, and accuſtomed to fight, in order to deſtroy her adverſary. The weaſel, though ſmaller, is a much more dangerous and formidable enemy to the rat, becauſe he can follow it into its retreat. Their ſtrength being nearly equal, the combat often continues for a long time, but the method of uſing their arms is very different. The rat wounds only by reiterated ſtrokes with his fore-teeth, which are better formed for gnawing than biting; and being ſituated at the extremity of the lever or jaw, they have not much force. But the weaſel bites cruelly with the whole jaw; and inſtead of letting go its hold, ſucks the blood from the wounded part. ſo that the rat is always killed.—The rat was firſt introduced into America by the Europeans in 1544, and is now the peſt of all that continent. In the neighbourhood of the lower parts of the river Volga, there is a ſmall variety of this ſpecies found in the deſerts, which does not weigh above ſix or ſeven drams. Mus.

6. The muſculus, or common mouſe, has a very long, ſcaly, and almoſt naked tail: the fore feet have each four toes; the hind feet five, the fifth or thumb having no claw: the head and body meaſure three inches and a half in length; the upper parts are tawny, and the lower parts whitiſh or aſh-coloured. This little animal, which inhabits all parts of the world, lives almoſt entirely in houſes, and follows mankind for the ſake of their proviſions. It feeds on almoſt every thing, ſuch as grain, bread, cheeſe, butter, oil, and every kind of food uſed by mankind, and drinks little: it is of mild and gentle manners, exceedingly timid, and very quick in all its motions. The mouſe never iſſues from his hole but in queſt of food, and runs in again upon the leaſt alarm. It goes not, like the rat, from houſe to houſe, unleſs forced, and is not near ſo deſtructive. It is alſo capable of being tamed to a certain degree, though not ſo perfectly as other animals. It has many enemies, from whom it can eſcape only by its agility and minuteneſs. Owls, birds of prey, cats, weaſels, hedge-hogs, and even rats, make war upon the mice, ſo that they are deſtroyed by millions; yet the ſpecies ſtill ſubſiſts by its amazing fecundity. They bring forth at all ſeaſons, and ſeveral times in the year: the litter generally conſiſts of five or ſix; and in leſs than 15 days the young diſperſe, and are able to provide for themſelves. Ariſtotle tells us, that having ſhut up a pregnant mouſe in a veſſel, along with plenty of grain, he found in a ſhort time after 120 mice, all ſprung from the ſame mother. Plate CCCXVIII fig. 2.

Several varieties of mice as to colour are found, ſome being altogether black, ſome yellowiſh, ſome ſpotted with white, ſome of a white colour with aſh-coloured ſpots, and the moſt beautiful of all, and the leaſt common, are entirely white, with red eyes: but as theſe agree in every other circumſtance, it is unneceſſary to deſcribe them more at large.

7. The ſylvaticus, or long-tailed field-mouſe, is larger than the common mouſe, meaſuring from the end of the noſe to the ſetting on of the tail four inches and an half, the tail four inches; the upper parts of the body are of a yellowiſh brown; the breaſt is yellow, and the belly white; the tail is covered with ſhort hair. The fore feet have four toes each; the hind feet five. Theſe animals are found in fields, gardens, and ſhrubberies. In ſome places they are called *bean mice*, from the havock they make among beans when firſt ſown. They feed alſo on nuts, acorns, and grain, of which they amaſs quantities, not proportioned to their wants, but to the capacity of the place where it is depoſited, inſomuch that a ſingle animal will collect more than a buſhel. Thus they provide for other animals as well as themſelves: the hog comes in for a ſhare; and the great damage done Fig. 6.

to

Mus. to the fields by these creatures, in rooting up the ground, is chiefly owing to their search after the concealed hoards of the field-mice. M. Buffon informs us, that he has often seen great damage done to the plantations by the field-mice. They carry off the new sown acorns; by following the furrow of the plough, they dig up one after another, not leaving a single seed. This happens chiefly in those seasons when the acorns are scarce: not finding a sufficient quantity in the woods, they come in quest of them in the cultivated fields, and often carry off such quantities that they corrupt in their magazines. These creatures, according to the same author, do more mischief in a nursery of trees than all the birds and other animals put together. The only way to prevent this damage is to lay traps at ten paces asunder, through the extent of the sown field. No other apparatus is necessary than a roasted walnut placed under a flat stone, supported by a stick. The animals come to eat the walnut, which they prefer to acorns; and as it is fixed to the stick, whenever they touch it, the stone falls down and crushes them to death. The same expedient M. Buffon also made use of with success against the short-tailed field-mouse, which also destroys acorns. In this way he found that upwards of 100 were taken each day, from a piece of ground consisting only of about 40 French arpents. From the 15th of November to the 8th of December, above 2000 were caught in this manner. Their numbers gradually diminished till the frost became severe, which is the time they retire into their holes to feed on their magazines. In autumn they are most numerous; for if provisions fail during the winter they devour one another. The long-tailed mice eat also the short tailed species, and even thrushes, blackbirds, &c. which they find entangled in snares. They first eat the brain, and then the rest of the body. M. Buffon once kept a dozen of these mice in a cage, and furnished them with food every morning at eight o'clock. One day they were neglected for about a quarter of an hour, when one of their number was eaten up by the rest; next day another suffered the same fate; and in a few days only one remained: all the others had been killed, and partly devoured; and even the survivor himself had his feet and tail mutilated. These animals are very prolific, producing more than once a-year, and bringing nine or ten at a birth. They generally make the nest for their young very near the surface, and often in a thick tuft of grass. During winter they frequent barns, stables, and out-houses.

8. The messorius, harvest mouse, or less long-tailed field mouse, is a very small species, or perhaps rather a variety of the former; and inhabits Hampshire, where it is very numerous, particularly during harvest. They form their nest above the ground, between the straws of the standing corn, and sometimes in thistles: it is of a round shape, and composed of the blades of corn. They bring about eight young ones at a time. These never enter houses; but are often carried, in the sheaves of corn, into ricks: and 100 of them have frequently been found in a single rick on pulling it down to be housed. Those that are not thus carried away in the sheaves, shelter themselves during winter under ground, and burrow deep, forming a warm bed for themselves of dead grass. They are the smallest of the British quadrupeds: the length from nose to tail is only two inches and a half; their tail two inches, and the weight one-sixth of an ounce. They are more slender than the other long-tailed field-mouse; and their back of a fuller red, inclining to the colour of a dormouse. Mus.

9. The agrarius, or rustic mouse, is about three inches long, and scarcely weighs half an ounce; the tail is only about half the length of the body and head; the upper part of the body is of a yellowish colour, with a dark line along the back; the belly and the legs are white; the head is oblong, with a sharp nose, and small ears lined with fur; the hind legs have each a dusky circle just above the foot. It inhabits Russia, and is found in Silesia, rarely in Germany. This species is migratory; and wanders about often in vast multitudes, doing immense injury to the corn: It burrows in the ground, forming a long gallery just below the surface, and a little elevated, leading to a larger chamber, in which considerable quantities of grain and seeds are stored up for winter provision. Plate CCCXIX. fig. 5.

10. The minutus, or minute mouse, has the upper parts of the body of a deep tawny or ferruginous colour, and the under parts whitish. It is about half the size of the common mouse, the tail being scarcely two inches long; the female is smaller than the male, and less elegant in her colours; the nose is somewhat sharp; the face is dusky, with some whiteness at the corners of the mouth; the ears are small, and almost hid in the fur; the feet are grey. This species inhabits Russia; where it is found in the corn-fields and in barns, and is plentiful in birch woods: it seems to wander about without any fixed places for its nest; and much greater numbers of males are found than of females. Fig. 1.

11. The vagus, or wandering mouse, is between two and three inches long: the colour of the upper parts of the body is a pale ash, waved with black, and having a black line along the middle of the back; the ears are large, oval, naked, and plaited. The legs are very slender, and the feet whitish, having four toes and a conical excrescence before, and five behind, all armed with long claws; the tail is longer than the body, very slender, prehensile at the end, of an ash colour above and whitish below; the head is oblong, with a blunt nose reddish at the tip, having yellow fore-teeth, and only two grinders on each side in the upper jaw. The female has eight teats.—This species inhabits the deserts of Tartary and Siberia, as high as the Ural, Irtish, Oby, and Jenisei. Is frequent in the birch woods, and lives in fissures of rocks, under stones, and in hollows of trees; feeding chiefly on seeds, and likewise on small animals of the same genus. It wanders about in great flocks, migrating from one place to another in the night; hybernates during winter, and is of a very chilly nature, so as even to become torpid and fall asleep, in a round form, in the cold nights of the month of June. It has carnivorous inclinations. Fig. 9.

12. The betulinus, or beech-mouse, has a considerable resemblance to the wandering mouse, but is somewhat smaller. The upper parts of the body are tawny, with a black line along the back, the under parts whitish or pale ash-colour; the nose is sharp, with Fig. 15.

Mus. with a red tip; the ears are ſmall, oval, plaited, brown, and briſtly at the ends; the limbs are very ſlender, with long and very ſeparable toes; the tail is ſlender and much longer than the body. This ſpecies inhabits the birch woods in the deſert plains of Iſchim and Baraba, and between the Oby and Jeniſei. It lives ſolitary, frequenting the hollows of decayed trees. It runs up trees readily, and faſtens on their branches with its tail; and by means of its ſlender fingers or toes, it can faſten even to a very ſmooth ſurface. It is a very tender animal, ſoon growing torpid in cold weather; and its voice is very weak.

Plate CCCXVIII fig. 15. 13. The pumilio, or dwarf mouſe, is of a browniſh aſh colour, with the fore-head and nape of the neck black, and having four black lines along the back meeting at the tail. It is ſcarcely two inches long, the tail is about two-thirds of the length of the body, and the whole animal, even when ſteeped many months in ſpirits, hardly weighs four ſcruples. The body is ſomewhat flattened; the regions of the eyes, the ears, and the noſe, are of a paler colour than the reſt of the body; all the feet have five toes, the thumb or inner toe of the fore feet being very ſmall, but diſtinctly furniſhed with a claw; the legs and feet are ſtrongly made; the tail is almoſt naked, and of a pale aſh-colour. This ſpecies, which was firſt deſcribed by Dr Sparrman, inhabits the foreſts of Sitſicamma near Ilangen river, 200 hours journey from the Cape of Good Hope.

Plate CCCXIX. fig. 16. 14. The ſaxatilis, or rock mouſe, is about four inches long, and weighs nearly nine drams; the tail is hairy, an inch and a half in length, of a brown colour above, and white beneath; the head is oblong, with a longiſh noſe, and oval downy ears, brown at the edges; the limbs are ſtrong; and the tail is thinly covered with hair; the upper parts of the body are of a brown colour, ſlightly mixed with yellowiſh or grey; the ſides are rather inclined to the latter colour; the belly is of a light aſh or whitiſh; the feet and legs are blackiſh; the ſnout is duſky, and ſurrounded with a ſlender white ring. This ſpecies is an inhabitant of the eaſtern parts of Siberia beyond lake Baikal, and of the deſerts of Mongul Tartary.—It burrows in the fiſſures of rocks, forming a winding oblique paſſage, which afterwards branches out into ſeveral others pointing downwards, and ending in a chamber, in which is a bed or neſt of ſoft herbs. It feeds chiefly on the ſeeds of the aſtragalus.

Plate CCCXVIII fig. 13. 15. The amphibious, or water-rat, with a long tail; the upper parts of the body being covered with black hair mixed with yellowiſh, and the under parts aſh-coloured; the ears ſcarcely appear above the fur; the feet have three toes on each, and the rudiments of a fourth. This ſpecies, of which there are ſeveral varieties, differing in the toes and in the colour, inhabits the whole of Europe, the northern parts of Aſia as far as the icy ſea, and North America.—They dwell chiefly near waters, forming burrows in their ſteep banks; about ponds and wet ditches; likewiſe in marſhy places, meadows, and gardens; feeding on roots, herbs, and ſhrubs; and on frogs, craw-fiſh, inſects, ſmall fiſh, and the fry of larger ones. They ſwim and dive with great facility, and live much in the water. They are very fierce, and bite bitterly. The fleſh of theſe animals is reckoned very delicate by ſome of the more ſavage inhabitants of the Ruſſian empire; and is eaten by the French along with that of the otter during lent. The female is ſmaller than the male, and has a greater yellowneſs of colour; ſhe has eight teats, four of which are placed on the breaſt and four on the belly. They procreate about the end of winter, at which time they ſmell ſtrongly of muſk, and produce as far as eight young ones in the month of April.

Mus.

Plate CCCXIX. fig. 2. 16. The alliarius, or garlic mouſe, has a ſhort tail; the ears rather large, and ſomewhat hairy; the body aſh coloured on its upper parts, and whitiſh underneath. The head and body meaſure ſomewhat more than four inches, the tail ſcarcely an inch and a half. This ſpecies inhabits Siberia, about the rivers Jeniſei, Kan, Lena, and Angara; and feeds on the roots of garlic, of which it lays up large ſtores in ſubterraneous burrows.

Fig. 8. 17. The rutilus, or red mouſe, has a ſhort tail; the ears are longer than the fur, which is tawny red on the back, light grey and yellow on the ſides, and whitiſh on the belly. The head and body meaſure about four inches, and the tail one.—This ſpecies inhabits Siberia, from the Oby as far as Kamtſchatka, and within the Arctic circle. It lives in holes and in hollows of trees; feeding on grain, and ſometimes on animals of the ſame genus. It comes often into houſes and barns, eating almoſt of every thing which comes in its way, but is particularly fond of fleſh. It is very lively, and runs about even on the ſnow the whole winter.

Plate CCCXVIII fig. 8. 18. The arvalis, or meadow-mouſe, is from three to ſix inches long, the female being much longer than the male, and the tail is little more than an inch: the head is large, with a blunt noſe, ſhort ears almoſt hid in the fur, and prominent eyes; the upper parts of the body are of a mixed ferruginous and black colour; the belly is deep aſh, and the legs and feet duſky;—the tail is terminated by a ſmall tuft of hair. There is a variety which is almoſt black.—This ſpecies inhabits all Europe, Siberia, Hircania, and Newfoundland; dwelling in buſhy places, corn-fields, meadows, and gardens, chiefly near waters; living on grain, nuts, acorns, and walnuts, which it collects into ſubterraneous burrows: but it appears to prefer corn to every other food. When the grain is ripe, they aſſemble from all quarters, and often do great damage by cutting the ſtalks of corn in order to come at the ears. They follow the reapers, and eat up all the fallen and neglected grain. When the gleanings are devoured, they flock to the new-ſown fields, and deſtroy the crop of the enſuing year. In winter moſt of them retire into the woods, where they feed upon filberts, acorns, and the ſeeds of trees. In particular years they appear in numbers ſo immenſe, that they would deſtroy every thing if they continued long: but they always kill and eat one another during a ſcarcity of proviſions. They beſides are devoured by the long-tailed field-mice, by foxes, wild-cats, and weaſels. Theſe creatures are often carried home in the ſheaves of corn, and 100 of them have been found in houſing a rick. In ſuch caſes it has been obſerved, that the dogs devoured all the mice of this ſort they could find, rejecting the common kind; and, on the contrary, the cats would touch none but the laſt. The female produces

Mus. several times a year, and brings from eight to twelve young at a birth: it has a ſtrong affection for them; one that was ſeduced into a wire-trap by placing its brood in it, was ſo intent on foſtering them, that it appeared quite regardleſs of its captivity. In Newfoundland, theſe mice are very deſtructive to gardens; but ſeldom do much damage in this way in Britain.

Plate CCCXIX. fig. 13. 19. The ſocialis, or ſocial mouſe, with a very ſhort ſlender tail, and naked, rounded, and very ſhort ears; the fore feet have each three toes and the rudiments of a fourth; the upper parts of the body are light-grey; the ſides, ſhoulders, and belly, are white. The head and body are ſomewhat more than three inches long, the tail half an inch. This ſpecies inhabits the ſandy deſerts between the Volga and Ural, near the Caſpian ſea, and in the mountains of Hircania.—They live in pairs, or in families, conſiſting of a male and a female with their young ones; and of theſe families vaſt numbers live together, the whole country being covered with little hills of earth thrown out of their burrows. They feed moſtly on tulip roots; and are preyed on by weaſels, polecats, crows, and otters. They ſwarm chiefly in ſpring, and rarely appear in autumn, at which ſeaſon it is ſuppoſed they migrate, or take ſhelter among the buſhes.

Fig. 12. 20. The œconomous, or economic mouſe, in its general form, reſembles the meadow-mouſe; but the body is rather longer and the belly larger. The ears are naked and hid in the fur; the colour is tawny; and the fore-feet have each three toes with the rudiments of a fourth. The head and body meaſure four inches and a quarter, the tail ſomewhat more than an inch. This ſpecies inhabits Siberia, from the river Irtiſh eaſtwards, in Kamtſchatka, and under the Arctic circle. They are called by Dr Pallas *mures œconomi*, from their curious way of living. They dwell moſtly in damp ſoils, forming burrows, with many chambers and numerous entrances, immediately under the turf. In theſe they lay up magazines of various vegetable food, chiefly bulbous roots; which they ſpread out in ſunny days to dry, and never touch them but in winter, living all ſummer on berries and other vegetables. The Kamtſchatkans hold theſe animals in great regard, and never deſtroy their hoards; they take away only part, and leave ſome caviare or other ſubſtance to ſupport them in its ſtead. This ſpecies ſometimes emigrates in vaſt multitudes, keeping a ſtraight courſe, like the lemmus, even over rivers; and are much infeſted on their march by birds, fiſh, wild hogs, foxes, and other wild beaſts. They begin their march from about the river Pengin in ſpring, and about the middle of July reach Ochotſka and Judoma, at a vaſt diſtance; and return in October. The Kamtſchatkans are much alarmed at their migrations which portend rainy weather and a bad chace; and when they find them lying weak and ſpent with fatigue after croſſing a river, give them every aſſiſtance in their power. The Tſchutſki are not ſo much attached to this animal, and make uſe both of their winter ſtores and of their carcaſes as food.

21. The gregalis, or gregarious mouſe, has a ſhort tail; the ears are longer than the fur; the fore-feet have each three toes and the rudiments of a fourth; the fur is dark aſh-coloured on the upper parts, and whitiſh below. This ſpecies is leſs than the economic mouſe, and longer than the ſocial; the female being five inches long and the male four. It inhabits the eaſtern parts of Siberia, where it dwells in arid places, forming burrows with numerous openings directly under the ſod; theſe lead to chambers in which it lays up large ſtores of roots, eſpecially thoſe of the lilium pomponii and garlic: It eats ſitting up. Mus.

22. The laniger, or woolly mouſe, with woolly fur of an aſh-colour, inhabits Peru and the north parts of Chili. It burrows in the earth, is very docile and cleanly, and is eaſily tamed; it lives on bulbous roots, eſpecially onions; the female breeds twice a-year, and brings five or ſix young ones at each litter. It is about ſix inches long, with a ſhort noſe, and ſmall ſharp-pointed ears; the fur is very long and exceedingly fine, almoſt like the threads of a ſpider's web, and was formerly employed as the very fineſt ſpecies of wool by the Peruvians.

Fig. 17. 23. The lagurus or rambling mouſe, has hardly any tail; the ears are ſhorter than the fur; the fore-feet have each three toes, and the rudiments of a fourth; the upper parts of the body are aſh-coloured mixed with duſky, and having a black line along the back. The head is long, with rough and ſwelling lips; the limbs are ſhort and ſlender; and the length of the body and head is between three and four inches. This ſpecies inhabits the deſarts near the rivers Ural, Irtiſh, and Jeniſei.—Each individual forms a round neſt of dried graſs in a burrow, having an oblique and a perpendicular entrance. They feed chiefly on the dwarf iris; but eat all kinds of grain, and devour other ſpecies of this genus, as well as one another. They ſleep very much, in a rolled-up form, and are very ſlow in their motions, like the marmot; but do not become torpid in winter. This ſpecies is very ſalacious; the males fight together for the females, and the conqueror generally devours the vanquiſhed. The female ſmells of muſk when in ſeaſon, produces ſeveral times in the year, and brings five or ſix young ones at a birth. They migrate in great troops; whence the name of rambling mice, which is given them by the Tartars.

fig. 4. 24. The torquatus, collared or ringed mouſe, has a very ſhort tail, with a tuft of hard briſtles at the end, which is blunt: the ears are ſhorter than the fur; the feet have each five toes; the fur is ferruginous, varied with grey, yellow, and duſky, having a whitiſh collar round the neck, and a dark line along the back. The head and body are ſomewhat more than three inches long, the tail ſcarcely one inch. It inhabits the northern parts of the Uralian mountains, and the marſhes near the frozen ocean; feeding chiefly on the lichen rangiferinus, lichen nivalis, and polygonus viviparus; theſe articles of food are ſtored up in burrows having numerous paſſages, which it digs under the turfy ſoil. This ſpecies is migratory, and reſembles the lemmus in its manners.

Plate CCCXVII. fig. 2. 25. The lemmus, or lemming, has a very ſhort tail: The head is pointed, having very long whiſkers, ſix of the hairs on each ſide being longer and ſtronger than the reſt; the mouth is ſmall, having two very long fore-teeth in each jaw, and the upper lip is divided; the eyes are ſmall and black; the ears are ſhorter than the fur, rounded, and reclined backwards; the fore-legs are very ſhort, having four ſlender hairy

Mus. toes on each, and a long ſharp claw like a cock's ſpur in place of the fifth or thumb; the hind-feet have five toes; the ſkin is very thin, and the upper parts of the body are black and tawny, diſpoſed in irregular blotches; the belly is white tinged with yellow. The length from noſe to tail is about five inches; of the tail, half an inch. This ſingular animal inhabits the mountains of Norway and Lapland. They feed on graſs, the catkins of the dwarf birch, the lichen rangiferinus, or rein-deer liverwort, and other ſuch vegetable productions: in ſummer they form ſhallow burrows under the turf, and in winter they make ſimilar long paſſages under the ſnow in queſt of food; for as they do not lay up magazines, and do not hybernate, they are obliged to ſearch for proviſions in the rigorous winter of theſe northern climes. When they foreſee, by ſome wonderful inſtinct of nature, the approach of a very ſevere winter, they leave their northern haunts in autumn, and emigrate in immenſe multitudes into the lower parts of Norway and Sweden, keeping a ſtraight line in ſpite of every obſtacle, moving moſtly in the night-time, and making prodigious havock of every vegetable they are able to reach. In this journey, which takes place at uncertain intervals, though generally about every ten years, they are deſtroyed by eagles, hawks, foxes, and other animals of prey, and numbers are drowned in paſſing rivers or lakes, which never interrupt their courſe, even proceeding on into the ſea: from all theſe concurring cauſes very few live to return to their native mountains, and thus a check is put to their ravages, as it takes years to repair their numbers ſufficiently for another invaſion. They are bold and fierce, ſo as even to attack men and animals, if they meet them in their courſe; and bite ſo hard as to allow themſelves to be carried a conſiderable way, hanging by their teeth to a ſtick, before they will quit their hold. The female breeds ſeveral times in the year, producing five or ſix young at a birth: ſometimes they bring forth during their migration, when they carry their young in their mouth or on their back.

There is a variety, the Sibiricus, or Siberian lemming, of a ſmaller ſize, and more uniform tawny colour, than the above. It inhabits the northern parts of the Uralian chain of mountains, and on the river Oby. It differs greatly in manners from the former: for it lays up in its burrows large ſtores of proviſions to ſerve during winter; whence it is probable that it does not migrate like the Norwegian kind.

There are nine or ten other ſpecies belonging to this diviſion.

III. Criceti, or *Hamſters*; having pouches on the cheeks, and ſhort hairy tails.

Plate CCCXIX. fig. 10. 1. The acredula, or Siberian hamſter, has large oblong oval furrowed ears: the upper parts of the body are of a yellowiſh and brown aſh-colour, the under parts hoary. The head and body meaſure four inches, and the tail near one. This ſpecies inhabits the diſtrict of Orenburgh in Siberia, near the Yaik or Ural. It lives in burrows, which it quits only in the night to ſeek for food: The Coſſacks ſay that it migrates out of the deſarts in vaſt multitudes; but Dr Pallas ſuſpects this to be a miſtake.

Plate CCCXVIII fig. 1. 2. The M. cricetus Germanicus, or German hamſter, is the moſt deſtructive of the whole rat-tribe. The males are about ten inches long, and the tail about three, but the females are ſcarcely more than half ſo large: the former weigh from 12 to 16 ounces, while the latter ſeldom exceed from four to ſix ounces: The head is thick, with a blunt noſe, and numerous whiſkers, large full black eyes, and large rounded open ears; uſually the head and back are of a reddiſh brown colour, with red cheeks; the ſides are paler, with three white ſpots; the breaſt, upper part of the fore-legs, and belly, are black; the feet are large and white, having four toes, and a claw inſtead of a fifth toe on the fore-feet, and five toes on each hind foot: The colour varies; ſometimes, though rarely, they are found entirely white or yellowiſh, or white with black ſpots on the back; ſometimes the ſnout is white, and the forehead aſh-coloured, or the lower jaw of a white colour.—There is a variety (the black German hamſter) which is entirely black, excepting the tip of the noſe, edges of the ears, and the feet, which are white. This ſpecies inhabits Siberia, the ſouth of Ruſſia, Poland, Sclavonia, Hungary, Sileſia, Bohemia, and Germany beyond the Rhine, eſpecially in Thuringia.—Each individual forms a ſubterraneous burrow, conſiſting of ſeveral chambers, with two holes or entrances leading from the ſurface; one of theſe is perpendicular, and the other, in which the excrements are lodged, is oblique; the holes of the females have ſeveral perpendicular openings, and each young one of her family is lodged in a ſeparate chamber: The chambers which are ſet apart for the lodging of themſelves and young are lined with ſtraw or graſs; the reſt are larger, and are appropriated for containing magazines of grain, beans, peaſe, lintſeed, vetches, and other ſuch ſeeds, each in a ſeparate cell. The chambers of the older animals are dug ſeveral feet deep, while thoſe of the younger ones ſeldom exceed a foot under the ſurface. The hamſter ſleeps during the winter like the marmots; when in a torpid ſtate, neither reſpiration nor any kind of feeling can be perceived. The heart, however, beats 15 times in a minute, which has been diſcovered by opening the cheſt. The blood continues to be fluid, but the inteſtines are not irritable; even an electrical ſhock does not awake him; but in the open air he never becomes torpid. When dug up in his ſtate of torpidity, the hamſter is found with his head bent under his belly between the two fore-legs, and thoſe behind reſt upon his muzzle. The eyes are ſhut; and when the eye-lids are forced open, they inſtantly cloſe again. The members are ſtiff, like thoſe of a dead animal, and the whole body feels as cold as ice. When diſſected during this ſtate, he ſeems to feel very little; ſometimes indeed he opens his mouth as if he wanted to reſpire; but his lethargy is too ſtrong to admit of his awakening entirely. This lethargy hath been aſcribed ſolely to a certain degree of cold; which indeed may be true with regard to dormice, bats, &c. But experience ſhows, that, in order to render the hamſter torpid, he muſt alſo be excluded from all communication with the external air: for when he is ſhut up in a cage filled with earth and ſtraw, and expoſed in winter to a degree of cold ſufficient to freeze the water, he never becomes torpid: but when the cage is ſunk four or five feet under ground, and well ſecured againſt the acceſs of the air, at the end of eight or ten days he is equally torpid as

Mus. if he had been in his own burrow. If the cage is brought up to the ſurface, the hamſter will awake in a few hours, and reſume his torpid ſtate when put below the earth. The experiment may be repeated with the ſame ſucceſs as long as the froſt continues. We have a farther proof that the abſence of the air is one of the cauſes of torpidity in the hamſter; for when brought up from his hole in the coldeſt weather, and expoſed to the air, he infallibly awakes in a few hours. This experiment ſucceeds as well in the night as in the day; which ſhows that light has no ſhare in producing the effect. It is curious to obſerve the hamſter paſſing from a torpid to an active ſtate. He firſt loſes the rigidity of his members, and then makes a profound reſpiration, but at long intervals. His legs begin to move, he opens his mouth, and utters diſagreeable and rattling ſounds. After continuing theſe operations for ſome time, he opens his eyes, and endeavours to raiſe himſelf on his legs. But all theſe movements are ſtill reeling and unſteady, like thoſe of a man intoxicated with liquor. He, however, reiterates his efforts till he is enabled to ſtand on his legs. In this attitude he remains fixed, as if he meant to reconnoitre and repoſe himſelf after his fatigue; but he gradually begins to walk, eat, and act in his uſual manner. This paſſage from a torpid to an active ſtate requires more or leſs time, according to the temperature of the air. When expoſed to a cold air, he ſometimes requires more than two hours to awake; and in a more temperate air he accompliſhes his purpoſe in leſs than one hour. It is probable that, when the hamſter is in his hole, this change is performed imperceptibly, and that he feels none of the inconveniences which ariſe from a ſudden and forced reviviſcence.

The hamſter is a very miſchievous animal; and ſo exceedingly fierce, that he ſeems to have no other paſſion but rage. In conſequence of this, he attacks every other animal that comes in his way, without regarding the ſuperior ſize or ſtrength of his antagoniſt; nay, as if he was ignorant of the method of ſaving himſelf by flight, he allows himſelf to be beat to pieces with a ſtick rather than yield. If he ſeizes a man's hand, he muſt be killed before he quits his hold. When the hamſter perceives a dog at a diſtance, he begins with emptying his cheek-pouches if they happen to be filled with grain, and which are ſo capacious as to hold a quarter of a pint Engliſh. He then blows them up ſo prodigiouſly, that the ſize of the head and neck greatly exceeds that of the body. Laſtly, he raiſes himſelf on his hind-legs, and in this attitude darts on his enemy. If he catches hold, he never quits it but with the loſs of life. But the dog generally ſeizes him behind, and ſtrangles him. This ferocious temper prevents the hamſter from being at peace with any other animal. He even makes war againſt his own ſpecies, not excepting the females. When two hamſters encounter, they never fail to attack each other, and the ſtronger always devours the weaker. A combat between a male and a female laſts longer than between two males. They begin by purſuing and biting each other; then each of them retires to a ſide as if to take breath; a little after, they renew the combat, and continue to fly and fight till one of them falls. The vanquiſhed uniformly ſerves for a repaſt to the conqueror.

The hamſters copulate about the end of April; when the males enter the apartments of the females, where they remain only a few days. If two males happen to meet in the ſame hole, a furious combat enſues, which generally terminates in the death of the weakeſt. The conqueror takes poſſeſſion of the female; and both, though at every other period they perſecute and kill each other, lay aſide their natural ferocity during the few days their amours continue. They even mutually defend each other againſt agreſſors; and if a hole is opened about this time, the female defends her huſband with the utmoſt fury. The females bring forth twice or thrice every year. Their litter is never fewer than ſix, and more frequently from 16 to 18. Their growth is very rapid. At the age of 15 days they begin to dig the earth; and ſoon after, the mother baniſhes them from her habitation; ſo that at the age of about three weeks they are abandoned to their own management. The mother in general diſcovers little affection for her offſpring; and when her hole is opened, flies in the moſt daſtardly manner, leaving her young ones to periſh. Her only ſolicitude at that time is to provide for her own defence. With this view ſhe digs deeper into the earth, which ſhe performs with amazing quickneſs. The young would willingly follow her; but ſhe is deaf to their cries, and even ſhuts the hole which ſhe has made.

The hamſters feed upon all kinds of herbs, roots, and grains, which the different ſeaſons produce, and even eat the fleſh of ſuch animals as they can conquer. They are particularly fond of places where liquorice grows, and feed much on its ſeeds. Their pace is very ſlow, and they do not climb; but they dig with vaſt quickneſs, and will gnaw through a piece of wood an inch and a half thick in a very ſhort time. As they are not adapted for long journeys, their magazines are firſt ſtocked with the proviſions which are neareſt their abode. This is the reaſon why ſome of the chambers are frequently filled with one kind of grain only. When the harveſt is reaped, they go to a greater diſtance in queſt of proviſions, and carry every article they can find, without diſtinction, to their granary. To facilitate the tranſportation of their food, nature has furniſhed them with two pouches in the inſide of each cheek. On the outſide, theſe pouches are membranous, ſmooth, and ſhining; and in the inſide there are a great many glands, which ſecrete a certain fluid, to preſerve the flexibility of the parts, and to enable them to reſiſt any accidents which may be occaſioned by the roughneſs or ſharpneſs of particular grains. Each of theſe receptacles is capable of containing an ounce and an half of grain, which, on his return to his lodgings, the animal empties, by preſſing his two fore-feet againſt his cheeks. When we meet a hamſter having his cheeks filled with proviſions, it is eaſy to ſeize him with the hand, without the riſk of being bitten; becauſe in this condition he has not the free motion of his jaws. But if he is allowed a little time, he ſoon empties his pouches, and ſtands upon his defence. The quantity of proviſions found in the holes depends on the age and ſex of the inhabitant. The old hamſters frequently amaſs 100 pounds of grain; but the young and the females content themſelves with a quantity much ſmaller. Their

Mus. object in laying up provisions, is not to nourish them during winter, which they pass in sleep, and without eating; but to support them after they awake in the spring, and previous to their falling into a torpid state, which resembles a profound sleep. At the approach of winter, the hamsters retire into their subterraneous abodes; the entrance to which they shut up with great address. Here the animal reposes, in the situation already described, upon a bed of straw, and in this state he is commonly dug up. They are preyed on by polecats, weasels, cats, dogs, foxes, and birds of prey; and are proscribed by man, on account of their devastations. In winter the peasants generally go a *hamster-nesting* as they call it; the retreat is known by a small eminence of earth raised near the oblique passage formerly described. The peasants dig down till they discover the hoard, and are generally well paid for their trouble; as they often find two bushels of corn, besides the skins of the animals, which are valuable furs: and it is remarkable, that the hair sticks so fast to the skin, that it cannot be plucked off without the utmost difficulty. In some seasons the hamsters are so numerous, that they occasion a dearth of corn. In one year about 11,000 skins, in a second 54,000, and in a third year 80,000, were brought to the town-house of Gotha, to receive a reward for their destruction. They are likewise destroyed by means of a paste formed of honey and flour boiled up with arsenic or powdered hellebore.

Plate CCCXIX. fig. 11. 3. The arenarius, or sand-hamster, has the upper parts of the body hoary; the sides, belly, limbs, and tail, pure white. It inhabits the sandy deserts of Baraba, on the river Irtish, in Siberia. The head is large, with a longish snout and a sharp nose, having very long whiskers, very large pouches, and great oval brownish ears; the body is short and thick, being about four inches long, and the tail rather more than one; the fur is very soft; the fore feet have only four toes each, the hind feet five, all the claws being white. This animal is very fierce and untameable: it forms burrows, like the preceding species; is chiefly active at night, and feeds mostly upon leguminous plants.

Fig. 7. 4. The songarus, or songar hamster, has the upper parts of the body of a grey ash-colour, marked with a black line along the back; the sides of the head and body are varied with large white and dark brown spots; the feet and belly are white. It is about three inches long, with a very short, thick, blunt, and hairy tail, little more than one-third of an inch in length. It inhabits the desert of Baraba, near the Irtish, in Siberia; where, like its congeners, it digs chambers for the reception of provisions. It is not, however, so fierce as some other species of the hamsters; but may be tamed when caught young, and grows very familiar.

There are two or three other species belonging to this division.

Fig. 18. 5. The phæus, or rice-hamster, has the upper parts of the body of a hoary ash-colour, with long dusky hairs along the back; the sides whitish; the circumference of the mouth, breast, belly, and extremities of the limbs, pure, white. It is about three inches and a half long, and the tail scarcely one inch.—This species inhabits about Zarizyn in the deserts of Siberia, and in the mountains of the north of Persia; where it does vast mischief in the rice fields. It is often caught in traps during winter, near stables and other out-houses, and never becomes torpid. Mus.

6. The furunculus, or Baraba hamster, has the upper parts of the body of a cinereous yellow, with a black streak on the back; the under parts dirty white. It is about three inches long, and the tail near one. This species inhabits Dauria, Siberia in the desart of Baraba, towards the Ob, between the Onon and Argum, and in the Chinese empire near lake Dalai; living chiefly on the seeds of the astragulus and atriplex: but its manners are unknown. Fig. 14.

IV. MYOTALPÆ†, or *Mole-rats*. These have no external ears, very small eyes, and a very short tail or none. They live entirely under ground like the moles. † Kerr — *Mures subterranei*, *Gmelin*.

1. The talpina, or Russian mole-rat, is of a dusky colour; has a very short tail, scarce appearing beyond the fur; and no external ears: the fore-teeth are long, extended from the mouth, and wedge-shaped: the eyes are very small, and hid in the fur: the feet have five toes; the fore-feet are very strong, flat, and formed for digging. It is about four inches long, and in the general form resembles the water-rat. As to colour, the head, back, and sides are dusky, and the belly and limbs white. There is a variety (the *nigra*), which is entirely black.—This species inhabits the plains of Russia and Western Siberia, scarcely extending beyond the Irtish, and never beyond the Oby. It is fond of a turfy soil, avoiding sandy or muddy places; and digs holes like those of the hamster, which it lines with soft grass, and fills with bulbous roots, throwing up hillocks of earth all along the tracks; each individual has its separate burrow: It works only in the night, and seldom comes out except in the season of love. Its sight is very weak in the day-time. It feeds chiefly on the roots of tulips, tuberose lathyrus, and tuberose phlomis. It procreates about the beginning of April, at which time it smells strongly of musk; and the females produce three or four young at a litter. Plate CCCXIX. fig. 3.

2. The capensis, or Cape mole-rat, is of a dark brown colour tinged yellowish, with the fore-part of the face, orbits, and regions of the ears, white: It has a very short tail, and no external ears; and is about five inches and a half long. It inhabits the Cape of Good Hope, where it infests the gardens. Plate CCCXVIII fig. 9.

3. The maritima, or African mole-rat, is of a pale brownish ash-colour mixed with yellowish on the upper parts, the sides and under parts paler: the tail is very short; and there are no external ears. It inhabits the sand hills adjacent to the sea at the Cape of Good Hope; and resembles the former species, but is much larger, measuring 12 or 13 inches long, and the head is more lengthened. It forms burrows in the sand like those of rabbits; and digs with surprising celerity. It runs slowly; but is very fierce, and bites severely. It feeds chiefly on the roots of ixiæ, antholyzæ, gladioli, and irides; and is reckoned good eating.

4. The aspalax, or Daurian mole-rat, is of a dirty yellow ash-colour on the upper parts, and whitish ash on the lower: has a very short tail, and no external ears; the eyes are very small, and deep-seated; the feet have each five toes, the claws of the fore feet being very long.—This species inhabits Dauria, and Siberia beyond the Irtish, between the Alei and Tschary sch rivers. Fig. 16.

Mus.

rivers. It digs very long burrows in the black turfy ſoil or firm ſand, throwing up numerous hillocks, which extend over a conſiderable ſurface; it works both with its feet and noſe, and ſometimes with its teeth. It feeds chiefly on the roots of bulbous plants. This ſpecies varies in ſize, thoſe of Dauria being near nine inches long, while thoſe farther eaſt are ſcarcely ſix.

Plate CCCXVIII fig. 7.

5. The typhlus, or blind mole-rat, is of a reddiſh aſh colour; and has no tail, external ears, or apparent eyes; the feet have each five toes; and the fore-teeth are broad. The body and head meaſure between ſeven and eight inches: the mouth is continually gaping, with ſhort wrinkled fore-teeth above, and very long ones below, likewiſe furrowed or wrinkled, none of them being hid by the lips; the body is covered with ſhort, ſoft, and cloſe ſet fur, which is of a duſky colour at the bottom, with the ends of a ruſty brown mixed with aſh-colour; the legs are very ſhort, having five toes on each foot armed with ſhort claws, and ſlightly connected by a ſhort membrane at their baſes. This ſpecies inhabits the ſouthern parts of Ruſſia, from Poland to the Volga. Each individual forms burrows under the turfy ſoil of very conſiderable extent, with many lateral paſſages, and throws out the earth at different diſtances, in large hillocks ſometimes two yards in circumference, and proportionally high. It works with its ſnout, feet, rump, and even with its teeth; and digs with great celerity, eſpecially when frightened, in which caſe it digs directly downwards. When irritated, it ſnorts, gnaſhes its teeth, raiſes its head in a menacing poſture, and bites with great ſeverity. It feeds on roots, eſpecially thoſe of the bulbous chærophyllum. It is entirely blind, though it has the rudiments of very ſmall eyes, which are covered over with a continuation of the ſkin; but it poſſeſſes the ſenſes of touch and hearing in a very eminent degree, to make up for the loſs of ſight. It breeds in ſpring and ſummer; and the female, which has two teats, brings from two to four young ones at a birth.

THE *Marmot*, *Agouti*, *Guinea-pig*, *Cavy*, *Jerboa*, *Dormouſe*, &c. which were formerly comprehended under the preſent genus in the Linnæan arrangement, have, in conſequence of more accurate inveſtigation, been lately diſjoined, and diſtributed under four new genera, *Myoxus*, *Arctomys*, *Dipus*, and *Cavia**. But as we are paſt the alphabetical order in which the three laſt of thoſe genera ſhould have been introduced, we muſt ſtill deſcribe the above animals (excepting the firſt) in this place; obſerving, however, to diſtinguiſh them according to their new generic arrangement.

* See Gmelin's edition of the *Syſtema Naturæ*; and the very elaborate and more ample edition in Engliſh, publiſhing by Kerr.

I. MYOXUS, or *Dormouſe*. See MYOXUS, the *Marmot*.

II. ARCTOMYS, the *Marmot*; the characters of which genus are: There are two wedge-like cutting teeth in each jaw; the grinders are five above, and four below, on each ſide; and there are perfect clavicles or collar-bones.

Plate CCCXVII. fig. 7.

1. The marmotta, or common marmot, has ſhort round ears; gibbous cheeks; a ſhort hairy tail; the upper parts of the body of a duſky brown colour, and the lower parts reddiſh. The body and head meaſure 16 inches, the tail ſix. This ſpecies inhabits the ſummits of the Alps and Pyrenean mountains, in dry places where there are no trees. It is more ſubject to be rendered torpid by cold than any other. In the end of September, or beginning of October, he retires into his hole, from which he comes not out till the beginning of April. His retreat is capacious, broader than long, and very deep, ſo that it can contain ſeveral marmots without any danger of corrupting the air. With their feet and claws, which are admirably adapted for the purpoſe, they dig the earth with ſurpriſing quickneſs, and throw it behind them. It is not a hole, or a ſtraight or winding tube, but a ſpecies of gallery made in the form of a Y, each branch of which has an aperture, and both terminate in one where the animal lodges. As the whole is made on the declivity of a mountain, the innermoſt part alone is on a level. Both branches of the Y are inclined, and the one is uſed for depoſiting the excrements of the animals, and the other for their going out and coming in. The place of their abode is well lined with moſs and hay, of which they make ample proviſion during the ſummer. It is even affirmed, that this labour is carried on jointly; that ſome cut the fineſt herbage, which is collected by others, and that they alternately ſerve as vehicles for tranſporting it to their dens. One, it is ſaid, lies down on his back, allows himſelf to be loaded with hay, extends his limbs, and others trail him in this manner by the tail, taking care not to overſet him. Theſe repeated frictions are aſſigned as the reaſon why the hair is generally rubbed off their backs. But it is more probable, that this effect is produced by their frequent digging of the earth. But, whatever may be in this, it is certain that they dwell together, and work in common at their habitations, where they paſs three-fourths of their lives. Thither they retire during rain or upon the approach of danger; and never go out but in fine weather, and even then to no great diſtance. One ſtands centinel upon a rock, while the others ſport on the graſs, or are employed in cutting it to make hay. When the centinel perceives a man, an eagle, a dog, &c. he alarms the reſt with a loud whiſtle, and is himſelf the laſt to enter the hole. They make no proviſions for winter; nor have they in that ſeaſon any occaſion for them, as lying aſleep all that time. As ſoon as they perceive the firſt approaches of the ſleeping ſeaſon, they ſet to work in ſhutting up the two entrances of their habitation; and this they perform with ſuch labour and ſolidity, that it is eaſier to dig the earth any where elſe than in the parts they have fortified. They are at this time very fat, weighing ſometimes 20 pounds; and they continue to be plump for three months; but afterwards they gradually decay, and are extremely emaciated at the end of winter. When diſcovered in their retreats, they are found rolled up in the form of a ball, covered with hay; and they are carried off in ſo torpid a ſtate, that they may be killed without ſeeming to feel pain. When taken young, they may be rendered nearly as tame as our other domeſtic animals. They are able to walk on their hind-feet, ſit up often on their haunches, and carry food to their mouths with their fore-feet. They learn to ſeize a ſtick, to dance, to perform various geſticulations, and to obey the voice of their maſter. Like the cat, the marmot has an antipathy againſt dogs. When he begins to be familiar in the houſe, and perceives that

Mus. that he is protected by his master, he attacks and bites dogs of the most formidable kind. Though not so large as a hare, he is stouter, and his strength is aided by a peculiar suppleness and dexterity. With his fore-teeth, which are pretty long, he bites most cruelly; he attacks not, however, either dogs or men unless previously irritated. If not prevented, he gnaws furniture and stuffs; and when confined, pierces even through wood. His voice resembles the murmuring of a young dog when caressed or in a sporting humour; but when irritated or frighted, he makes a whistling noise, so loud and piercing, that it hurts the ear. The marmots eat every thing presented to them; as flesh, bread, fruit, roots, pot-herbs, may-bugs, grashoppers, &c. but milk and butter they prefer to every other aliment. Though less inclined to theft than the cat, they endeavour to slip into the dairy, where they drink great quantities of milk, making, like the cat, a murmuring noise expressive of pleasure. Milk is also the only liquor that is agreeable to them; for they rarely drink water, and they refuse wine. They procreate but once a-year; and the female, after three or four weeks, produces two, three, or four young. The growth of their young is very quick; they live only nine or ten years; and the species is neither numerous nor much diffused. They are easily caught when on plain ground, but with difficulty in their holes, as they dig deeper when in danger of being taken, except in winter when torpid; at which time they are caught in great numbers. They are searched for partly on account of their flesh, which is tender and delicate; partly for their skins; and partly for their fat, which is esteemed medicinal by the inhabitants of the Alps: but they are chiefly taken by the Savoyards for the purpose of being exposed as shows through various parts of Europe. The marmot would make very good eating, if it had not always a disagreeable flavour, which cannot be concealed but by strong seasonings.

Plate CCCXVII. fig. 6. 2. The monax, or American marmot, is about the size of a rabbit. It has short rounded ears; the nose and cheeks are bluish; the body is of a deep brown colour; the tail is longish, and very hairy. This species inhabits the warmer states of North America and the Bahamas. It forms holes in the clefts of rocks and under the roots of trees, in which it passes the winter in a torpid state; though it is uncertain if those of the Bahamas hybernate, as the climate of these islands is very mild. It feeds on vegetables; and its flesh is very good, resembling that of a pig.

Plate CCCXIX. fig. 23. 3. The bobac, or Polish marmot, is of a greyish colour, mixed with long dusky hairs on the upper parts of the body, the under parts yellowish: It has small oval ears, small eyes, a hairy straight tail, and the fore-feet have each a claw in place of the thumb or fifth toe. The head and body measure sixteen inches, the tail four and a half. This species inhabits the dry and sunny places of the mountains, from the Boristhenes through the temperate climes of Asia as far as China and Kamtschatka. It forms very deep burrows, in which societies of 20 or more live together, each individual having a particular nest at the bottom of the common gallery, which is often three or four yards deep, and from which numerous galleries or passages branch off to the several apartments. They go about in search of food in the morning and middle of the day, placing a centinel to give warning of approaching danger. The bobak is a timid animal, and feeds only on vegetables, chiefly oleraceous plants. It sits up on the hams, and carries its food with the fore paws to its mouth, and defends itself in the same posture. It may be easily tamed even when old: it then eats cabbages or bread, and laps milk; but refuses to drink water. In summer it feeds voraciously; but remains torpid all winter, except when kept in very warm places: and even then it eats very little; and escapes if possible, that it may get to some place proper for hybernating; but returns to its master in spring. The flesh resembles that of a hare, though rank; the fat is used for dressing leather and furs; and the skins are employed for clothing by the Russians. The female has eight teats; and probably brings forth early, as by the month of June the young ones are half grown.

Plate CCCXVII. figs. 1. & 4. 4. The citillus, or earless marmot, is of a variable colour, has a convex head, no external ears, and a short hairy tail. This species inhabits the southern parts of Russia as far as Kamtschatka, and the islands between Asia and America; is found in Persia and China; but is now rarely met with in the rest of Europe. They dwell in open, high, dry, and uncultivated places, preferring turfy and loamy soils, near the high roads, and never frequent bogs or woods. Each individual has its separate burrow, in which, for provision in the beginning and end of winter, it lays up magazines of grain, tender vegetables, and berries; sometimes, though rarely, the carcases of mice and small birds are added. In the middle of winter these animals lie torpid during the greatest severity of the frost. From the very beginning of spring, as soon as the weather becomes mild, they go out in the day time in quest of food, which they eat sitting on their haunches, carrying it in their fore paws to the mouth. The male is very easily tamed; but the female is fiercer, more given to bite, and is less easily made tame; she goes between three and four weeks with young, and brings forth from three to eight young ones about the beginning of May. The fur is very good in the spring, and the flesh is reckoned tolerable. They are preyed on by polecats, weasels, hawks, carrion crows, and cranes.

This animal varies considerably both in size and colour, being sometimes as large as the common marmot, and sometimes not larger than the water-rat. In general the colour is of a yellowish ash on the upper parts, and dirty white on the belly, (the *zizel* of Buffon); sometimes it is variegated either with waves or small spots of white, (the souslik of the same author.) Some are white on the upper parts, and waved with tawny or yellow, being pale yellow on the lower parts of the body, and having a longish tail, with shed hair like that of a squirrel: others are of a grey colour on the upper parts of the body, spotted with white; the under parts being of a yellowish white, with white orbits, and the face, between the eyes and the nose, of a brownish yellow, with a short tail.

Fig. 9. 5. The empetra, or Canadian marmot, is of a mixed grey colour on the upper parts of the body; the lower parts orange; having short rounded ears, and a hairy tail. It is rather larger than a rabbit, and the tail is about two inches and a half long; the head is round, with a blunt nose, and short rounded ears; the cheeks, are

Mus. are full, and of a grey colour; the face is dusky, with a black nose; the hair on the back is grey at the roots, black in the middle, and whitish at the tips; the belly and legs are of an orange colour; the feet are black and naked, having four long, slender, divided toes, and the rudiments of a thumb on each fore-foot, and five similar on each behind, all armed with pretty strong claws. This animal was described by Mr Pennant from a living specimen in possession of Mr Brooks, which was very tame, and made a hissing noise. It inhabits Canada, Hudson's Bay, and the other northern parts of America.

Five or six other species of arctomys, some of them suspected to be only varieties, are described by Kerr.

III. Dipus, or *Jerboa*. There are two fore-teeth in each jaw: the tail is long, and tufted at the end: but the most striking characteristic of this genus is the enormous length of the hind feet and extreme shortness of the fore-paws. From this conformation, instead of walking or running on all fours, they leap or hop on the hind feet like birds, making prodigious bounds, and only use the fore paws for burrowing, or for carrying their food to the mouth like squirrels. From this peculiarity of conformation, the kanguru, G. xix. sp. 15. and Philip's opossum, sp. 16. of the same genus (Mr Kerr observes), ought to have been arranged with this genus of the jerboa; but from a rigid adherence to artificial system, they are by Dr Gmelin ranked with the genus opossum, on account of the number and arrangement of their teeth. See the article Didelphis.

1. The jaculus, or common jarboa, has four toes on all the feet, and a claw in place of a thumb or fifth toe on each fore-foot. The body is somewhat more than seven inches long, and the hind legs and thighs are longer than the body. The upper parts are of a pale tawny colour, and the under parts white: the ears and feet are flesh coloured. The female has eight distantly placed teats. These animals inhabit Egypt, Arabia, Calmuck Tartary, and southern Siberia. They frequent firm hard ground, and fields covered with grass and herbs, where they form burrows of several yards long in a winding direction, leading to a large chamber about half a yard below the surface; and from this a second passage is dug to within a very little of the surface, by which they can escape when threatened with danger. When at rest, they sit with their hind legs bent under their belly, and keep the fore legs so near the throat as hardly to be perceptible. They eat grain and herbage like the hare. Their dispositions are mild, and yet they can never be perfectly tamed. Two that were kept in a house in London burrowed almost through the brick-wall of the room where they were; they came out of their hole at night for food; and when caught were much fatter and sleeker than when confined to their box.

This animal is eaten by the Arabs, who call it the *lamb of the children of Israel*. It has been particularly noticed and described by Mr Bruce in his Abyssinian Travels *. He says it inhabits the smoothest places of the desart, especially those where the soil is fixed gravel. In this it burrows, and has its hole divided into many apartments. It seems, however, to be afraid of the ground falling in upon it, as it chooses always to dig under the roots of some bushy plant or shrub. It particularly delights in those places which are frequented by the cerastes or horned viper, though it would appear that the serpent sometimes preyed upon it; for Mr Bruce tells us that he once saw a jerboa taken out of the belly of a female viper big with young, and almost consumed by the digestive powers of the animal. It is a very cleanly creature, and keeps its hair always in excellent order. It jumps about with great agility, in which it is assisted by its long tail, which we should suppose would rather be a hinderance to it. The Arabs of the kingdom of Tripoli in Africa teach their grehounds to hunt the Antelope, by learning them first to catch jerboas; and so agile are the latter, that Mr Bruce has often seen, in a large court-yard or inclosure, the grehound employed a quarter of an hour before he could kill his diminutive adversary; and had he not been well trained, so that he made use of his feet as well as his teeth, he might have killed two antelopes in the time he could have killed one jerboa. This animal is very fat, and the flesh well coloured; the buttocks, thighs, and part of the back, are roasted and eaten by the Arabs, as already mentioned, and taste almost exactly like a young rabbit, but without the strong smell of the latter. It is said, that the flesh dried in the air is very nourishing, and prevents costiveness; so that it seems to be endowed also with medicinal qualities. The animal is found in most parts of Arabia and Syria, and in all parts of the southern desarts of Africa; but nowhere in such plenty as in the Cyrenaicum or Pentapolis. In his journey thither, Mr Bruce employed several Arabs, together with his own servants, to kill these animals with sticks, that their skins might not be hurt with shot. Having got them dressed in Syria and Greece, and sewed together, making use of the tail, as in ermine, for the lining of a cloak, he found they had a very good effect, making a finer and glossier appearance the longer they were worn.

Bochart thinks this animal is the *Saphon* of holy writ, and displays a vast deal of learning on the subject. But this opinion is refuted by Mr Bruce, who observes, that the saphon is gregarious, and builds in rocks; being likewise distinguished for its feebleness, which it supplies by its wisdom; and none of these characters apply to the jerboa: "therefore (says Mr Bruce) though he chews the cud in common with some others, and was in great plenty in Judea, so as to be known to Solomon, yet he cannot be the saphon of Scripture." He supposes with great probability, that it is the creature termed the *mouse*, Isa. lxvi. 17.; and says that in the Arabic version the word is expressly translated *jerboa*. See the article Saphon.

2. The sagitta, or Arabian jerboa, has three toes on the hind feet, and no thumb or fifth toe on the fore-paws. It is only about six inches long, and the tail rather shorter than the body; the soles of the hind-feet and bottom of the toes are covered with a very thick coat of hair; the head is more rounded than that of the preceding animal, and the ears are much longer than the head. It inhabits Arabia, and near the Irtish in Siberia, where it frequents the sandy plains.

The two following are distinguished as different species by Mr Pennant, though Dr Gmelin seems not to have considered them as distinct from the preceding.

* Vol. V. p. 121.

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Plate CCCXVIII fig. 16.

A. The ægyptius, or Egyptian Jerboa, has three toes only on the hind feet; and four toes, with a ſcarcely apparent thumb or fifth toe, furniſhed with a claw, on the fore-paws.

This animal Mr Pennant ſuppoſes to be the *mus bipes* of the ancients, *mus ſagitta* of Pallas, *jerbo* of Buffon, and *daman Iſrael* of the Arabs. He ſays, that it inhabits Egypt, Barbary, Paleſtine, the deſerts between Baſora and Aleppo, the ſandy tracks between the Don and Volga, and the hills ſouth of the Irtiſh.

Fig. 17. B. The ſibiricus, or Siberian jerboa, with three toes on the hind feet, and two ſpurious toes ſome way up the legs; five toes on the fore feet, the thumb or fifth toe having no nail. Of this ſpecies Mr Pennant diſtinguiſhes four varieties, the major, medius, minor, and pumilio; differing in ſize, colour, &c. But they all (he ſays) agree in manners. They burrow in hard ground, clay, or indurated mud; not only in high and dry ſpots, but even in low and ſalt places. They dig their holes with great celerity, not only with their fore-paws but with their teeth, and flinging the earth back with their hind feet ſo as to form a heap at the entrance. The burrows are many yards long, but not above half a yard deep. Theſe run obliquely; and end in a large ſpace or neſt, the receptacle of the fineſt herbs. They have uſually but one entrance; yet by a wonderful ſagacity they work from their neſt another paſſage to within a very ſmall ſpace of the ſurface, which in caſe of neceſſity they can burſt through, and ſo eſcape.

They ſleep rolled up with their head between their thighs: At ſun-ſet they come out of their holes, clear them of the filth, and keep abroad till the ſun has drawn up the dews from the earth. On approach of any danger, they immediately take to flight, with leaps of a fathom in height, and ſo ſwiftly that a man well mounted can hardly overtake them. They ſpring ſo nimbly, that it is impoſſible to ſee their feet touch the ground. They do not go ſtraight forward, but turn here and there till they gain a burrow, whether it is their own or that of another. When ſurpriſed, they will ſometimes go on all fours, but ſoon recover their attitude of ſtanding on their hind legs like a bird: even when undiſturbed, they uſe the former attitude; then riſe erect, liſten, and hop about like a crow. In digging or eating they drop on their fore legs; but in the laſt action will often ſit up and eat like a ſquirrel. They are eaſily tamed; and ſeek always a warm corner. They foretel cold or bad weather by wrapping themſelves cloſe up in hay; and thoſe which are at liberty ſtop up the mouths of their burrows. In a wild ſtate they live much on oleraceous plants: the ſmall ſtature of the pumilio is attributed to its feeding on ſaline plants. Thoſe of the middle ſize, which live beyond the lake Baikal, feed on the bulbs of the *lilium pomponium*, and they gnaw the twigs of the *robinia caragana*. When confined, they will not refuſe raw meat or the entrails of fowls. —They are the prey of all leſſer rapacious beaſts; and the Arabs, who are forbidden all other kinds of mice, eſteem theſe the greateſt delicacies. The Mongols have a notion that they ſuck the ſheep: certain it is they are during night very frequent among the flocks, which they diſturb by their leaps. Theſe animals breed often in the ſummer; in the ſouthern parts in the beginning of May; beyond Baikal not till June. They bring perhaps eight at a time, as they have ſo many teats. They ſleep the whole winter without nutriment. About Aſtracan, they will ſometimes appear in a warm day in February; but return to their holes on the return of cold.

Mus.

3. The cafer, or Cape jerboa, has four toes on the hind-feet and five on the paws; the tail is very hairy, and tipt with black.—This ſpecies, which inhabits the Cape of Good Hope, is larger than any of the foregoing, being 14 inches long, the tail 15, the ears three. It is called *aerdmannetie*, or little earth man, and *ſpringen haas*, or leaping hare, by the Dutch at the Cape. It has a grunting voice; is very ſtrong, and leaps 20 or 30 feet at one bound. It burrows with its fore feet; and ſleeps ſitting on its hind legs, with the knees ſeparated, the head between, and holding its ears with the fore-paws over its eyes. It is eaten by the natives; and is caught by pouring water into its hole, which forces it to come out.

Plate CCCXIX. fig. 6.

4. The meridianus, Caſpian jerboa, or long-legged mouſe, has five toes behind and three before, with the rudiments of a thumb or inner toe. It is five inches long, and the tail three.—This ſpecies inhabits the ſandy deſerts between the Ural and Volga, near the Caſpian.—It forms burrows, with three entrances, about a yard in depth; and feeds chiefly on the ſeeds of the pterococci and aſtragali.

Fig. 19. 5. The lamaricinus, or marſh jerboa, has five toes behind and three before, with the rudiments of a fourth; the tail is obſcurely annulated. The body and head meaſure about five inches and a half in length; the tail is about the ſame length.—This ſpecies inhabits the ſalt marſhes near the Caſpian ſea; and is ſuppoſed to feed on the fruit of the tamarix and nitrarium, which grow in theſe marſhes. Under the roots of theſe trees it forms very deep burrows, which have two entrances. It is a very elegant little animal. There are two or three other ſpecies of this genus.

IV. The Cavia, or *Cavy*; a genus which ſeems to hold a midle place between the murine and the leporine quadrupeds. The characters are: there are two wedge-like cutting teeth in each jaw, and eight grinders in both jaws: the fore-feet are furniſhed with four or five toes: the hind-feet with three, four, or five each: the tail is either very ſhort or entirely wanting: there are no clavicles or collar-bones.

Plate CCCXVII. fig. 13.

1. The paca, or ſpotted cavy, has five toes on all the feet; and the ſides are marked with rows of grey or pale yellow ſpots. The body and head meaſure about two feet in length; the tail is like a ſmall button, and ſo extremely ſhort as to be hardly apparent; the mouth is very ſmall, and the upper lip is divided; the noſtrils are very large, and the muzzle is garniſhed with long whiſkers; the ears are ſhort and roundiſh; the eyes are large, prominent, and browniſh; the two cutting teeth in each jaw are very long and of great ſtrength; the hind legs are longer than the fore.—This ſpecies inhabits Braſil, Guiana, and probably all the warmer parts of America. It lives in fenny places near rivers, burrowing in the ground, and keeping its hole exceedingly clean, to which it has always three diſtinct outlets: It grows very fat, and is eſteemed a great delicacy. The female has

Mus. two teats ſituated between the hind-thighs, and has only a ſingle young one at a litter.—It is difficult to take this animal alive. When ſurpriſed in its hole, which the hunters lay open both before and behind, it defends itſelf, and even bites fiercely.—It is, however, eaſily accuſtomed to a domeſtic life. Unleſs induſtriouſly irritated, it is gentle and tractable, fond of adulation, and licks the hands of the perſon who careſſes it. It knows thoſe who take care of it, and readily diſtinguiſhes their voices. When gently ſtroaked on the back, it ſtretches itſelf out, lies down on its belly, by a ſmall cry expreſſes its acknowledgement, and ſeems to aſk a continuance of the favour: but if ſeized in a rough manner, it makes very violent efforts to eſcape. When kept in a wooden cage or box, this animal remains perfectly tranquil during the day, eſpecially when plentifully ſupplied with food. It ſeems even to have an affection for its retreat as long as the day laſts; for, after feeding, it retires ſpontaneouſly into it. But when night approaches, by perpetual reſtleſſneſs and agitation, and by tearing the bars of its priſon with its teeth, it diſcovers a violent deſire of getting out. Nothing of this kind happens during the day, unleſs it has occaſion for ſome natural evacuation; for it cannot endure the ſmalleſt degree of dirtineſs in its little apartment; and when about to void its excrements, always retires to the moſt diſtant corner it can find. When its ſtraw begins to ſmell, it often throws it out, as if it meant to demand freſh litter. This old ſtraw it puſhes out with its muzzle, and goes in queſt of rags or paper to replace it. In a female cavy, the following extraordinary inſtance of cleanlineſs was obſerved. A large male rabbit being ſhut up with her when ſhe was in ſeaſon, ſhe took an averſion to him the moment he voided his excrement in their common apartment. Before this ſhe was very fond of him; licked his noſe, ears, and body; and allowed him to take almoſt the whole food that was given her. But as ſoon as the rabbit had infected the cage with his ordure, ſhe retired into the bottom of an old preſs, where ſhe made a bed with paper and rags, and returned not to her old lodging till ſhe ſaw it neat, and freed from the unclean gueſt which had been preſented to her.

2. The agouti, which is about the ſize of a rabbit, has a very ſhort tail; four toes on the fore feet, and three on the hind ones; the upper parts of the body of a browniſh colour mixed with red and black, the rump orange, and the belly yelloviſh. Of this ſpecies there are three varieties mentioned by authors, viz. the leſſer cunicularis or long-noſed cavy, which is about the ſize of a rabbit; the leporina or larger rabbit, called the *java hare*, or *javan cavy*, which is as large as a hare; and the americana, which ſeems to be but little known. They all inhabit South America and the Weſt India iſlands; dwelling in hollow trees, or burrowing in the ground. They ſearch for their food, which is entirely vegetable, during the day, and carry it home with them to their dwellings: when feeding they ſit on their hind legs, and carry their food with the fore-paws to the mouth. They grow very fat, and are very good eating, their fleſh being white and ſavoury like that of a rabbit. They breed frequently in the ſame year, the female bringing three, four, or five young ones at a birth. They grunt like pigs, are very voracious, and when fat, their fleſh is white like that of a rabbit, but dry. What food they cannot immediately conſume they hoard in their retreats, and eat at their leiſure. Their pace is hopping like that of a hare or rabbit; they beat the ground like them with their feet, when angry; they ſtop and liſten to the ſound of muſic; and they take ſhelter, when purſued, in their holes, or in hollow trees.—They are hunted with dogs. When one of them is forced among the cut ſugar canes, he is ſoon taken; becauſe theſe grounds being generally covered a foot thick with ſtraw and leaves, at each leap he ſinks in this litter, ſo that a man may overtake and ſlay him with a baton. He commonly runs very nimbly before the dogs; and when he gains his retreat, he lies ſquat, and remains obſtinately in his concealment. The hunters are obliged to chace him out by filling his hole with ſmoke. The animal, half ſuffocated, utters mournful cries; but never iſſues forth unleſs when puſhed to the laſt extremity. His cry, which he often repeats when diſturbed or irritated, reſembles that of a ſmall hog. If taken young, he is eaſily tamed, and goes out and returns of his own accord.

Plate CCCXVII. fig. 10. 11.

3. The cobaya, or reſtleſs cavy, has four toes on the fore and three on the hind-feet, with no tail: it is about ſeven inches in length; and the whole body is white, uſually variegated with irregular orange and black blotches. This ſpecies inhabits Braſil; but its manners in a wild ſtate are not mentioned by authors. In a domeſtic ſtate, as they appear in Europe, they are very reſtleſs, and make a continual noiſe.—They feed on all kinds of herbs; but eſpecially on parſley, which they prefer to grain or bread; and they are likewiſe fond of apples and other fruits. They eat precipitately like the rabbit, little at a time, but very often. Buffon ſays they never drink; but Gmelin, that they drink water. Their voice is commonly a kind of grunt like a young pig; when engaged in their amours, it reſembles the chirp of a bird; and when hurt, they emit a ſharp cry. They are of a tame and gentle, but ſtupid diſpoſition. The female breeds at two months old, bringing from four or five to ten or twelve young ones at a birth, though ſhe has only two teats; and breeds very often during the year, as ſhe goes but three weeks with young, and takes the male 12 or 15 days after littering. As they breed ſo faſt, their multitudes would be innumerable, if there were not ſo many enemies which deſtroy them. They cannot reſiſt either cold or moiſture: when cold, they aſſemble and crowd cloſe together; in which caſe they often all periſh together. They are alſo devoured in great numbers by cats, and many are killed by the males. Rats are ſaid to avoid their haunts. They are called in England *Guinea-pigs*, from their being ſuppoſed to come from that country. Fig. 9.

4. The magellanica, or Patagonian cavy, has hardly any tail; the ſides of the noſe are garniſhed with tufts of curly hair and long numerous whiſkers. This ſpecies inhabits the country about Port Deſire in Patagonia, and is of conſiderable ſize, ſometimes weighing 26 pounds. It has the ſame manners with the reſt of the genus; it ſits on its hind legs, burrows in the ground, and feeds on vegetables. The fleſh is very white, and has an excellent flavour. Fig. 12.

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Plate CCCXVII.

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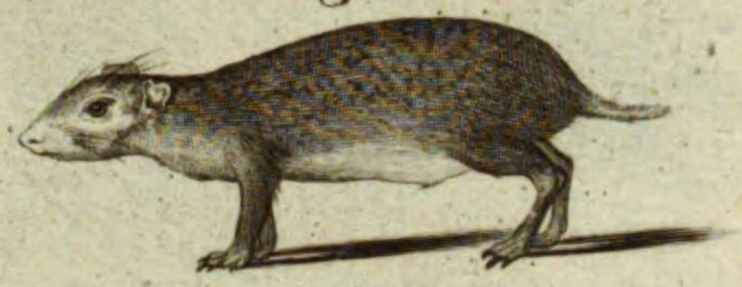

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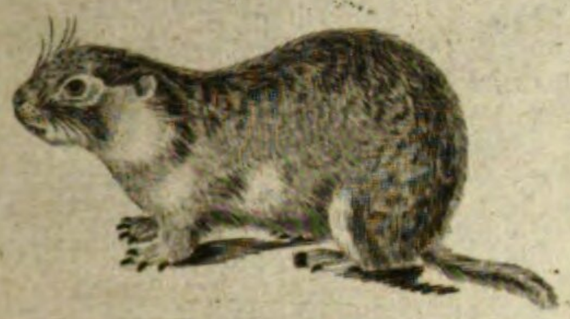

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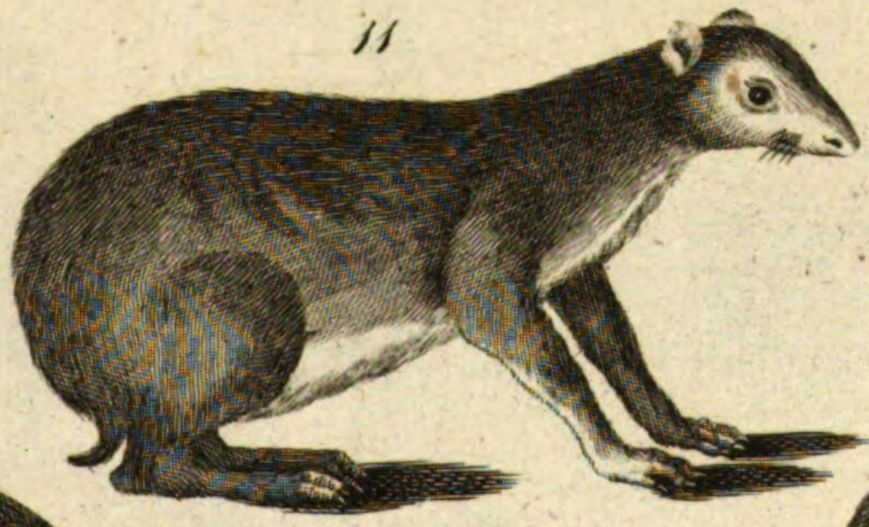

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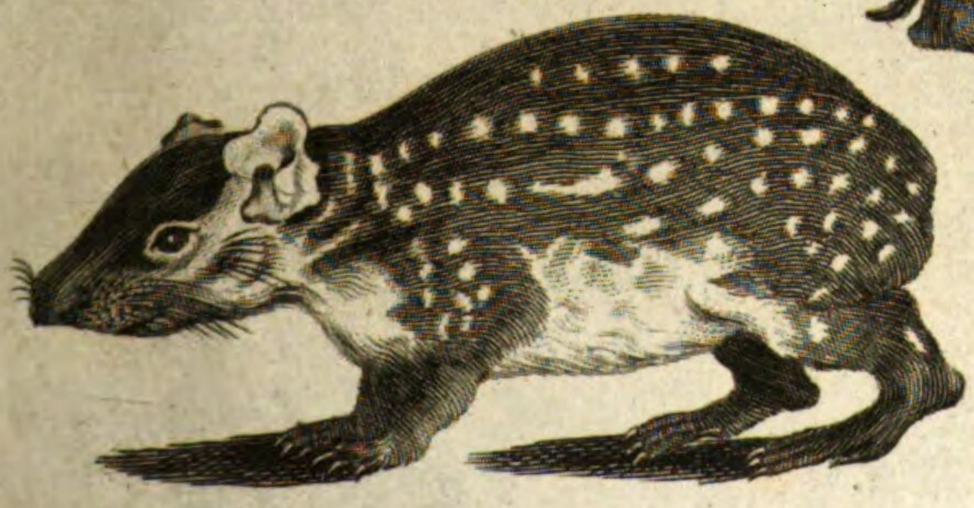

A. Bell Prin. Wal. Sculptor fecit.

MUS.

Plate CCCXVIII.

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A. Bell Prin. Wat. Sculptor fecit.

Mus.

Plate CCCXIX.

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A. Bell Prin. Mal. Sculptor fecit.

Mus. Plate CCCXIX. fig. 22.

5. The capybara, or thick-noſed tapir, has no tail; the hind feet have each three webbed toes. The length of the animal, when full grown, is above two feet and a half: the head and noſe are very large and thick; having ſmall, erect, rounded, naked ears, and large black eyes: and the noſe is garniſhed with numerous black whiſkers; in each jaw are two large ſtrong fore-teeth, and eight grinders; the legs are ſhort, having the toes connected by a web, and their extremities are guarded with a kind of hoofs inſtead of claws; the neck is ſhort and thick; the hair is ſhort, rough, and harſh, like briſtles, being longeſt on the back, and moſt of them are yelloviſh in the middle and black at both ends.—This ſpecies inhabits the eaſtern ſide of South America, from the iſthmus of Darien to Braſil and Paraguay; living in fenny woods near the large rivers, ſuch as the Amazons, Oroonoko, and Plata. They ſwim and dive remarkably well, and keep for a long time under water. They catch fiſh at night with great dexterity, and bring them on ſhore to eat them; which they do ſitting on the hind legs, and holding the food in the fore-paws like the apes. They likewiſe live on fruits and vegetables, eſpecially the ſugar cane, and feed only in the night. They keep together in large herds, making a great noiſe like the braying of aſſes, and do vaſt miſchief in gardens. They grow very fat; and the fleſh is eaten, being tender, but has an oily and fiſhy flavour. In the breeding ſeaſon, one male and one female live together, and the female only produces a ſingle one at a birth. Theſe animals are eaſily rendered tame, and become very familiar.

Plate CCCXVII. fig. 3.

6. The acuſchy, or olive cavy, has a ſhort tail; the upper parts of the body are of an olive colour, the under parts whitiſh. This ſpecies inhabits Guiana, Cayenne, and Braſil.—It is about the ſize of an half-grown rabbit, is eaſily tamed, and is reckoned very delicate food. The female brings one, ſometimes two, at a litter. This animal reſembles the agouti, but is uniformly ſmaller, has a tail of ſome length, and is of a different colour. It inhabits the woods, living on fruits; abhors water; and ſometimes, though rarely, makes a cry like that of the reſtleſs cavy.

There are five or ſix other ſpecies deſcribed by authors as belonging to the cavy genus. Two of them, however, have been lately marked by Dr Gmelin under a new genus, *Hyrax*; which, as there was not an opportunity of introducing it in the order of the alphabet, we ſhall here ſubjoin, together with the deſcriptions of the ſpecies as given by Mr Kerr.

V. HYRAX, or *aſhkoko*. There are two broad and diſtant fore-teeth above; four contiguous, broad, flat, notched fore-teeth below; and four large grinders on each ſide in both jaws. The fore feet have four toes, the hind feet only three. There is no tail; and the clavicles are wanting.

Fig. 9.

1. The capenſis, or cape aſhkoko, "has flat nails on all the toes, except one toe of each hind-foot which is armed with a ſharp pointed claw. It inhabits the Cape of Good Hope.—This animal is about the ſize of a rabbit, being about 15 inches long; the head is ſhort, with the back part very thick, and the ſnout very ſhort and blunt; the eyes are ſmall; the ears are oval and open, brown, woolly, and half hid in the fur; the legs are very ſhort, the upper joints of both being concealed beneath the ſkin; the hind legs are rather longer than the fore; the feet are large, black, and naked: the body is ſhort, thick, and contracted, with a prominent belly, and is covered with a ſoft woolly fur of a yelloviſh brown or greyiſh colour, hoary at the roots; the ſides are of a dirty whitiſh grey; and along the back is a browniſh ſtripe: this fur is interperſed with longer and coarſer black hairs, and a few very coarſe long briſtles. The fore-feet have four ſhort, ſcarce divided, thick toes, furniſhed with flat nails; the two outer toes of the hind-feet are ſimilar, but the inner toe is longer, and has a ſharp claw. This animal has a ſharp voice, and acute ſenſe of hearing; its gait is very wavering and unſteady, owing to the ſhortneſs of its thighs and unequal length of the hind and fore legs; notwithſtanding of which it is very active, and moves by leaps: it is very cleanly, lives entirely on vegetable food, drinks little, is fond of heat, and burrows in the ground. In manners and general appearance, this animal reſembles the marmot and cavy; in the conformation of its toes it has ſome analogy with the maucauco; but from the circumſtances of the teeth it cannot be ranked with the laſt; and the peculiarity of the feet has cauſed Dr Gmelin to ſeparate it from both of the former."

Mus, Muſa.

Plate CCCXIX. fig. 21.

2. The ſyriacus, or Syrian aſhkoko, (Bruce, Schreber), "has ſoft tender nails on all the toes. It inhabits Syria and Ethiopia.—The body of this is more lengthened than that of the former, and the ſnout more oblong. The fur is of a reddiſh grey colour like that of the wild rabbit, the throat, breaſt, and belly, being white; all over the body a number of long, ſtrong, and poliſhed hairs are ſcattered among the fur. The body and head of the individual deſcribed by Mr Bruce meaſured 17 inches. The ears are broad, open, and rounded; each ſide of the mouth is garniſhed with long whiſkers. In walking, which is performed creeping low with the belly almoſt touching the ground, the hind feet are uſed as far as the heel. All the toes have ſhort, broad, weak, flat nails, except the inner toe of the hind foot, which is provided with a flat crooked nail ſomewhat longer than the reſt; the ſoles of the feet are formed of fleſhy naked protuberances, divided by furrows. It lives moſtly about the mouths of caves or clefts in rocks; is gregarious; feeds entirely on vegetables; is mild, feeble, timid, and eaſily tamed, and has no voice or cry. Mr Bruce is of opinion, that this animal is the gannim or Daman Iſrael of the Arabs, and the ſaphan of ſacred ſcriptures, which has erroneouſly been tranſlated *the rabbit*.—Its fleſh is very white, but is not eaten by the Abyſſinians or Mahometans. The ſame celebrated traveller is of opinion, that it ruminates or chews the cud."

MUSA, the PLANTAIN-TREE: A genus of the monœcia order, belonging to the polyandria claſs of plants; and in the natural method ranking under the eighth order, *Scitamineæ*. The calyx of the male hermaphrodite is a ſpatha or ſheath; the corolla is dipetalous; the one petal erect and quinquedentate; the other nectariferous, concave, and ſhorter; there are ſix filaments; five of which are perfect; one ſtyle; the germen inferior and abortive. The female hermaphrodite has the calyx, corolla, filaments, and piſtil of the male hermaphrodite, with only one filament perfect; the berry is oblong, and three-angled below. The

Muſa. moſt remarkable ſpecies are, 1. The *paradiſaica*, or plantain; 2. The *muſa ſapientum*, or banana-tree. See Plate CCCXX.

The firſt ſort is cultivated in all the iſlands of the Weſt Indies, where the fruit ſerves the Indians for bread; and ſome of the white people alſo prefer it to moſt other things, eſpecially to the yams and caſſada bread. The plant riſes with a ſoft ſtalk 15 or 20 feet high; the lower part of the ſtalk is often as large as a man's thigh, diminiſhing gradually to the top, where the leaves come out on every ſide;—theſe are often eight feet long, and from two to three feet broad, with a ſtrong fleſhy midrib, and a great number of tranſverſe veins running from the midrib to the borders. The leaves are thin and tender, ſo that where they are expoſed to the open air, they are generally torn by the wind; for as they are large, the wind has great power againſt them: theſe leaves come out from the centre of the ſtalk, and are rolled up at their firſt appearance; but when they are advanced above the ſtalk, they expand and turn backward. As theſe leaves come up rolled in the manner before-mentioned, their advance upward is ſo quick that their growth may almoſt be diſcerned by the naked eye; and if a fine line is drawn acroſs level with the top of the leaf, in an hour's time the leaf will be near an inch above it. When the plant is grown to its full height, the ſpikes of flowers will appear in the centre, which is often near four feet in length, and nods on one ſide. The flowers come out in bunches; thoſe in the lower part of the ſpike being the largeſt; the others diminiſh in their ſize upward. Each of theſe bunches is covered with a ſpath or ſheath of a fine purple colour, which drops off when the flowers open. The upper part of the ſpike is made up of male or barren flowers, which are not ſucceeded by fruit, but fall off with their covers. The fruit or plantains are about a foot long, and an inch and a half or two inches diameter: it is at firſt green, but when ripe of a pale-yellow colour. The ſkin is tough; and within is a ſoft pulp of a luſcious ſweet flavour. The pikes of fruit are often ſo large as to weigh upwards of 40 lb. The fruit of this ſort is generally cut before it is ripe. The green ſkin is pulled off, and the heart is roaſted in a clear fire for a few minutes, and frequently turned: it is then ſcraped, and ſerved up as bread. Boiled plantains are not ſo palatable. This tree is cultivated on a very extenſive ſcale in Jamaica; without the fruit of which, Dr Wright ſays, the iſland would ſcarce be habitable, as no ſpecies of proviſion could ſupply their place. Even flour or bread itſelf would be leſs agreeable, and leſs able to ſupport the laborious negro, ſo as to enable him to do his buſineſs or to keep in health. Plantains alſo fatten horſes, cattle, ſwine, dogs, fowls, and other domeſtic animals.

The leaves being ſmooth and ſoft are employed as dreſſings after bliſters. The water from the ſoft trunk is aſtringent, and employed by ſome to check diarrhœas. Every other part of the tree is uſeful in different parts of rural economy. The leaves are uſed for napkins and table-cloths, and are food for hogs.

The ſecond ſort differs from the firſt, in having its ſtalks marked with dark purple ſtripes and ſpots.—The fruit is ſhorter, ſtraighter, and rounder: the pulp is ſofter, and of a more luſcious taſte. It is never eaten green; but when ripe, it is very agreeable, either eaten raw or fried in ſlices as fritters; and is reliſhed by all ranks of people in the Weſt Indies. Muſa.

Both the above plants were carried to the Weſt Indies from the Canary Iſlands; whither, it is believed, they had been brought from Guinea, where they grow naturally. They are alſo cultivated in Egypt, and in moſt other hot countries, where they grow to perfection in about 10 months from their firſt planting to the ripening of their fruit. When their ſtalks are cut down, there will ſeveral ſuckers come up from the root, which in ſix or eight months will produce fruit; ſo that by cutting down the ſtalks at different times, there is a conſtant ſucceſſion of fruit all the year.

In Europe there are ſome of theſe plants preſerved in the gardens of curious perſons, who have hot-houſes capacious enough for their reception, in many of whom they have ripened their fruit very well; but as they grow very tall, and their leaves are large, they require more room in the ſtove than moſt people care to allow them. They are propagated by ſuckers, which come from the roots of thoſe plants which have fruited; and many times the younger plants, when they are ſtinted in growth, will alſo put out ſuckers.

The fruit of the banana-tree is four or five inches long, of the ſize and ſhape of a middling cucumber, and of a high, grateful flavour: the leaves are two yards long, and a foot broad in the middle; they join to the top of the body of the tree, and frequently contain in their cavities a great quantity of water, which runs out, upon a ſmall inciſion being made into the tree, at the junction of the leaves. Bananas grow in great bunches, that weigh a dozen pounds and upwards. The body of the tree is ſo porous as not to merit the name of wood; the tree is only perennial by its roots, and dies down to the ground every autumn.

When the natives of the Weſt Indies (ſays Labat) undertake a voyage, they make proviſion of a paſte of banana; which, in caſe of need, ſerves them for nouriſhment and drink: for this purpoſe they take ripe bananas; and having ſqueezed them through a fine ſieve, form the ſolid fruit into ſmall loaves, which are dried in the ſun or in hot aſhes, after being previouſly wrapped up in the leaves of Indian flowering-reed.—When they would make uſe of this paſte they diſſolve it in water, which is very eaſily done; and the liquor, thereby rendered thick, has an agreeable acid taſte imparted to it, which makes it both refreſhing and nouriſhing.—The banana is greatly eſteemed, and even venerated, by the natives of Madeira, who term it the *forbidden fruit*, and reckon it a crime almoſt inexpiable to cut it with a knife; becauſe, after diſſection, it exhibits, as they pretend, a ſimilitude of our Saviour's crucifixion; and to cut the fruit open with a knife, is, in their apprehenſion, to wound his ſacred image.

Some authors have imagined, that the banana-tree was that of the leaves of which our firſt parents made themſelves aprons in Paradiſe. The ſacred text, indeed, calls the leaves employed for that purpoſe *fig-leaves*; and Milton, in a moſt beautiful but erroneous deſcription, affirms the bearded or Bengal fig to have been the tree alluded to. But beſides that the fruit of the banana is often by the moſt ancient authors

called

Muſa. called a *fig*, its leaves, by reaſon of their great ſize and ſolidity, were much more proper for a veil or covering than thoſe of the Bengal fig, which are ſeldom above ſix or eight inches long and three broad. On the other hand, the banana leaves being three, four, and five feet long, and proportionably broad, could not fail to be pitched upon in preference to all others; eſpecially as they might be eaſily joined, or ſewed together, with the numerous thread-like filaments that may, with the utmoſt facility, be peeled from the body of this tree.

Some have ſuppoſed the Abyſſinian plant *enſete* to be a ſpecies of muſa. It is ſaid to be a native of the province of Narea, where it grows in the great marſhes and ſwamps for which that province is remarkable, owing to the many rivers which originate in that country, and have but a ſmall declivity to the ocean. This plant, as well as the coffee-tree, is ſaid to have been unknown in Abyſſinia before the arrival of the Galla, who imported them both along with them. It comes to great perfection about Gondar; but the principal plantations of it are in that part of Maitſha and Gouth, to the weſt of the Nile, where it is almoſt the ſole food of the Galla who inhabit that country. Maitſha is almoſt entirely on a dead level; ſo that the rains ſtagnate and prevent the ſowing of grain. Were it not for the enſete, therefore, the Galla would have ſcarce any vegetable food. Mr Bruce * thinks that the enſete may have been cultivated in ſome of the gardens of Egypt about Roſetto, but that it was not a native of the country. He ſtrongly controverts the opinion that this plant is a ſpecies of muſa. "It is true (ſays he), the leaf of the banana reſembles that of the enſete: it bears figs, and has an excreſcence from its trunk, which is terminated by a conical figure, chiefly differing from the enſete in ſize and quantity of parts; but the figs of the banana are of the ſize and figure of a cucumber, and this is the part which is eaten. This fig is ſweet, though mealy, and of a taſte highly agreeable. It is ſuppoſed to have no ſeeds, though in fact there are four ſmall black ſeeds belonging to every fig. But the figs of the enſete are not eatable: they are of a ſoft tender ſubſtance; watery, taſteleſs, and in colour and conſiſtence reſembling a rotten apricot: they are of a conical form, crooked a little at the lower end; about an inch and an half in length, and an inch in breadth where thickeſt. In the inſide of theſe is a large ſtone half an inch long, of the ſhape of a bean or caſhew-nut, of a dark-brown colour; and this contains a ſmall ſeed, which is ſeldom hardened into fruit, but conſiſts only of ſkin. The long ſtalk that bears the figs of the enſete ſprings from the centre of the plant, or rather is the body or ſolid part of the plant itſelf. Upon this, where it begins to bend, are a parcel of looſe leaves; then grows the fig upon the body of the plant without any ſtalk; after which the top of the ſtalk is thickſet with ſmall leaves, in the midſt of which it terminates the flower in the form of an artichoke; whereas in the banana, the flower in form of the artichoke grows at the end of that ſhoot or ſtalk, which proceeds from the middle of the plant, the upper part of which bears the row of figs. The leaves of the enſete are of a web of longitudinal fibres cloſely ſet together; the leaves grow from the bottom without ſtalks: whereas the banana is in form like a tree, and has been miſtaken for ſuch. One half of it is divided into a ſtem, the other is a head formed with leaves; and in place of the ſtem that grows out of the enſete, a number of leaves, rolled round together like a truncheon, ſhoots out of the heart of the banana, and renews the upper as the under leaves fall off: but all the leaves of the banana have a long ſtalk; this fixes them to the trunk, which they do not embrace by a broad baſe or involucrum as the enſete does. Muſa.

"But the greateſt differences are ſtill remaining.—The banana has by ſome been miſtaken for a tree of the palmaceous kind, for no other reaſon but a kind of ſimilarity in producing the fruit on an excreſcence or ſtalk growing from the heart of the ſtem: but ſtill the muſa is neither woody nor perennial; it bears the fruit but once; and in all theſe reſpects it differs from trees of the palmaceous kind, and indeed from all ſort of trees whatever. The enſete, on the contrary, has no naked ſtem; no part of it is woody: the body of it, for ſeveral feet high, is eſculent; but no part of the banana plant can be eaten. As ſoon as the ſtalk of the enſete appears perfect and full of leaves, the body of the plant turns hard and fibrous, and is no longer fit to be eaten: before, it is the beſt of all vegetables. When boiled, it has the taſte of the beſt new wheat-bread not perfectly baked. When you make uſe of the enſete for eating, you cut it immediately above the ſmall detached roots, and perhaps a foot or two higher, as the plant is of age. The green muſt be ſtripped from the upper part till it becomes white; when ſoft, like a turnip well boiled, if eat with milk or butter, it is the beſt of all food, wholeſome, nouriſhing, and eaſily digeſted."

Our author now proceeds to conſider an hieroglyphic ſometimes met with in Egypt, viz. "the figure of Iſis ſitting between ſome branches of the banana tree, as is ſuppoſed, and ſome handfuls of ears of wheat. You ſee likewiſe the hippopotamus ravaging a quantity of the banana tree. Yet the banana is merely adventitious in Egypt: it is a native of Syria: it does not even exiſt in the low hot country of Arabia Felix; but chooſes ſome elevation in the mountains where the air is temperate; and is not found in Syria farther to the ſouthward than Lat. 34°.

For theſe reaſons Mr Bruce thinks, that the banana not being a plant of the country, "could never have entered into the liſt of their hieroglyphics; for this reaſon it could not figure any thing regular or permanent in the hiſtory of Egypt or its climate. I therefore imagine (adds he), that this hieroglyphic was wholly Ethiopian; and that the ſuppoſed banana, which, as an adventitious plant, ſignified nothing in Egypt, was only a repreſentation of the enſete; and that the record in the hieroglyphic of Iſis and the enſete-tree was ſomething that happened between harveſt, which was about Auguſt, and the time that the enſete-tree came in uſe, which was in October.—The hippopotamus is generally thought to repreſent a Nile that has been ſo abundant as to be deſtructive. When, therefore, we ſee upon the obeliſks the hippopotamus deſtroying the banana, we may ſuppoſe it meant, that the extraordinary inundation had gone ſo far as not only to deſtroy the wheat, but alſo to retard or hurt the growth of the enſete, which was to ſupply its place."

* *Travels*, vol. v. p. 36.

MUSÆUS,

Muſæus, Muſca.

MUSÆUS, an ancient Greek poet, was, according to Plato and Diodorus Siculus, an Athenian, the ſon of Orpheus, and chief of the Eleuſinian myſteries inſtituted at Athens in honour of Ceres: or, according to others, he was only the diſciple of Orpheus: but from the great reſemblance which there was between his character and talents and thoſe of his maſter, by giving a ſtronger outline to the figure he was called his *ſon*, as thoſe were ſtyled the *children of Apollo* who cultivated the arts of which he was the tutelar god.

Muſæus is allowed to have been one of the firſt poets who verſified the oracles. He is placed in the Arundelian marbles, epoch 15. 1426 B. C. at which time his hymns are there ſaid to have been received in the celebration of the Eleuſinian myſteries. Laertius tells us, that Muſæus not only compoſed a theogony, but formed a ſphere for the uſe of his companions; yet as this honour is generally given to Chiron, it is more natural to ſuppoſe, with Sir Iſaac Newton, that he enlarged it with the addition of ſeveral conſtellations after the conqueſt of the golden fleece. The ſphere itſelf ſhows that it was delineated after the Argonautic expedition, which is deſcribed in the aſteriſms, together with ſeveral other more ancient hiſtories of the Greeks, and without any thing later; for the ſhip Argo was the firſt long veſſel which they had built: hitherto they had uſed round ſhips of burthen, and kept within ſight of the ſhore; but now, by the dictates of the oracle, and conſent of the princes of Greece, the flower of that country ſail rapidly through the deep, and guide their ſhip by the ſtars.

Burney's Hiſtory of Muſic.

Muſæus is celebrated by Virgil in the character of hierophant, or prieſt of Ceres, at the head of the moſt illuſtrious mortals who have merited a place in Elyſium. Here he is made the conductor of Æneas to the receſs where he meets the ſhade of his father Anchiſes.

A hill near the citadel of Athens was called *Muſæum*, according to Pauſanias, from Muſæus, who uſed to retire thither to meditate and compoſe his religious hymns; at which place he was afterwards buried. The works which went under his name, like thoſe of Orpheus, were by many attributed to Onomacritus. Nothing remains of this poet now, nor were any of his writings extant in the time of Pauſanias, except a hymn to Ceres, which he made for the Lycomides. And as theſe hymns were likewiſe ſet to muſic, and ſung in the myſteries by Muſæus himſelf in the character of prieſt, he thence perhaps acquired from future times the title of *muſician* as well as of *poet*; the performance of ſacred muſic being probably at firſt confined to the prieſthood in theſe celebrations, as it had been before in Egypt, whence they originated. However, he is not enumerated among ancient muſicians by Plutarch; nor does it appear that he merited the title of *ſon* and *ſucceſſor to Orpheus* for his muſical abilities, ſo much as for his poetry, piety, and profound knowledge in religious myſteries.

MUSCA, the Fly, in zoology; a genus of inſects belonging to the order of diptera. The mouth is furniſhed with a fleſhy proboſcis, and two lateral lips; but it has no palpi. This genus is divided into two different ſections: 1. Thoſe with ſimple antennæ. 2. Thoſe which are furniſhed with a lateral hair or feather. Thoſe have downy bodies, though ſcarce perceptibly ſo; and have either a lateral plume or feather on the antennæ, or a ſimple hair on the ſide of the antennæ. The piloſæ have a few hairs ſcattered upon their bodies, principally upon the thorax; they have either a lateral feather or a lateral hair. Under theſe diviſions are comprehended about 400 different ſpecies, as enumerated in Dr Gmelin's edition of the *Syſtema Naturæ*. "Variety (as Mr Barbut obſerves) runs through their forms, their ſtructure, their organization, their metamorphoſes, their manner of living, propagating their ſpecies, and providing for their poſterity. Every ſpecies is furniſhed with implements adapted to its exigencies. What exquiſiteneſs! what proportion in the ſeveral parts that compoſe the body of a fly! What preciſion, what mechaniſm in the ſprings and motion! Some are oviparous, others viviparous; which latter have but two young ones at a time, whereas the propagation of the former is by hundreds. Flies are laſcivious troubleſome inſects, that put up with every kind of food. When ſtorms impend, they have moſt activity, and ſting with greateſt force. They multiply moſt in hot moiſt climates; and ſo great was formerly their numbers in Spain, that there were fly-hunters commiſſioned to give them chace. The vapour of ſulphur or arſenic deſtroys them; and their numbers may be reduced by taking them in phials of honeyed water, or between boards done over with honey." There are 129 ſpecies, principally diſtinguiſhed by the peculiarities in their feelers.

Muſca ‖ Muſci.

Musca, a name given to ſuch perſons among the Romans as officiouſly thruſt themſelves into the company of their ſuperiors and thoſe who deſpiſed them, by finding means of getting admittance to entertainments without invitation, and without a welcome: So that *muſcæ* were the ſame as paraſites, who were frequently by the Greeks termed Μυῖαι. See Parasite.

MUSCADINE, a rich wine, of the growth of Provence, Languedoc, Cividad, &c.—The word, as well as the liquor, is French: Some fetch its original from *muſk*; the wine being ſuppoſed to have a little of the ſmell of that perfume; others from *muſca*, a "fly," becauſe the flies are extremely fond of its grapes; as the Latins had their *vinum apianum*, ſo called *ab apibus*, from the bees which fed on it.

The way of making muſcadine at Frontignac is as follows: They let the muſcadine grapes grow half dry on the vine; as ſoon as they are gathered, they tread and preſs them immediately, and tun up the liquor, without letting it ſtand and work in the fat; the lee occaſioning its goodneſs.

MUSCHENBROECK (Peter de), a very diſtinguiſhed natural philoſopher and mathematician, was born at Utrecht a little before 1700. He was firſt profeſſor of theſe in his own univerſity, and afterwards invited to the chair at Leyden, where he died full of reputation and honours in 1761. He was a member of ſeveral academies; particularly the Academy of Sciences at Paris. He was the author of ſeveral works in Latin, all of which ſhow the greateſt penetration and exactneſs in this way. He was alſo very conſummate in the knowledge of law.

MUSCI, Mosses, one of the ſeven families or claſſes into which all vegetables are divided by Linnæus in the *Philoſophia Botanica*. The ancients took the moſs of trees to be the effect of a diſorder or diſcompoſure of the texture of the bark; or at moſt a kind of little filaments ariſing from the bark: but the moderns find, by ſeveral obſervations, that moſſes are all

Muſci. all real diſtinct plants, whoſe ſeed, being extremely ſmall, is incloſed in little capſulæ; which burſting of themſelves, the ſeed is carried off by the winds; till, falling into the inequalities of the bark of trees, it is there ſtopped, takes root, and feeds at the expence of the tree, as mouldineſs does on bread, &c.

What the botanical writers ſtrictly underſtand by the word *moſs*, is a claſs of plants appearing of an inferior rank to the common vegetables; the leſs perfect genera of which have been ſuppoſed to be wholly deſtitute of flower or ſeed, or any thing analogous to either, and to conſiſt of ſimple, ſimilar, and uniform parts; the genera a little above theſe have ſome diverſity of parts, and carry ſomething that looks analogous to vegetation in the common way, having a reſemblance of thoſe parts which ſerve other plants for their fructification. The more perfect genera of the moſſes not only conſiſt of different parts, but have alſo their appropriated organs containing a pulpy matter, which finally becomes dry, and aſſumes the form of a fine and ſubtile powder, compoſed of granules, each of which is either a ſeed or a granule of farina, ſerving for the propagation of the ſpecies.

The more imperfect moſſes are diſtinguiſhed from the others by their appearance to the naked eye; they are either in form of a fine lanugo or down covering the ſurface of different bodies; or elſe they appear as ſlender filaments, or foliaceous bodies, floating about in the water; or as filaments of a tougher texture, hanging down from the branches of old trees; or as little ſhrubs, or ſingle horns, growing erect on the parched earth of mountains and heathy places; or finally, as broad and foliaceous bodies ſpreading themſelves over the dry barks of trees or rocks, without any pedicle or other ſupport.

The more perfect kinds of moſſes are found in the ſhape of ſmall but regular plants, divided into ſeveral branches, and clothed with leaves: theſe are of various forms and ſtructures; ſome being broad and thin, others ſlender as hairs; ſome pellucid, others opake; ſome ſmooth, others hairy. From the alæ of theſe leaves in ſome kinds, and from the ſummit of the ſtalks in others, there ariſe heads or capſules of various figure and ſtructure, but all unicapſular; ſome of theſe are naked, and others covered with a calyptra or hood; ſome ſtand on long pedicles, and others are placed cloſe to the ſtalks. Theſe heads are uſually called *capſulæ*, which contain their ſeeds or farina, and their pedicles *ſetæ*, in the *mnia*, *hypna*, *brya*, and *polytricha*, &c.

Theſe capſules in ſome are covered with a calyptra or hood; in others they are naked. Of the firſt kind are the *ſplachnum*, *polytricum*, *mnium*, *bryum*, *hypnum*, *fontinalis*, and *buxbaumia*; and of the latter ſort, the *lycopodium*, *porella*, *ſphagnum*, and *phaſcum*.

The ſubſtance with which the heads or capſules of all the moſſes are filled, reſembles either ſeeds, or the ſmall globules of the farina of flowers, which all reſemble ſeeds of particular figures in miniature. The fructifications of theſe minute plants ſeem to be either from theſe, as ſeeds falling to the earth; or, according to the opinion of ſome, they ſeem to contain only farina in the capſules, which impregnating certain bulbs or nodules in the alæ of the leaves, cauſe them to grow and vegetate, as is ſeen in ſome of the larger plants; as in the bulbs produced in the alæ of the leaves of the dentaria, and of the lilies, and ſome others. The former opinion, of the powder in the heads or capſules being actually perfect ſeeds, is the more probable, as the bulbs in the alæ of the leaves are found only in ſome of the hypna, and others of a few other genera; whereas the propagation is as quick and certain in thoſe which have none of them as in thoſe which have; and the want of female parts of fructification, which makes ſo many deſiderata in the Linnæan ſyſtem of botany, is eaſily made up, and the whole explained according to the uſual courſe of nature in other vegetables, by allowing the powder in the capſules to be real ſeeds, and the ſmall globules on the pointals ſurrounding the aperture of the capſule, the farina. Muſci.

The opinion of the moſſes growing from theſe nodules in the alæ of the leaves, or from the impregnated ends of the branches which had received the powder from the capſules, was originally founded on the obſerving that the trailing or branched hypna annually grew out in length, from the extremities of all their branches, and annually loſt as much of the old ſtalk at the root as they gained of the new at the ſummit; but it appears from farther obſervations, that they are real ſeeds which are contained in form of powder in the capſules; ſince the brya, and many others, are found growing from ſmall points or ſpots, which are aſſemblages of their minute leaves, propagated on the ground, under the old ones juſt where the powder of the capſules has fallen; and though it be allowed that the hypna and other trailing moſſes do grow from the ends of the branches, yet they may alſo be produced in form of new plants, from regular and perfect ſeeds ſhed from the capſules. It is certain that the brya are by this means propagated and ſpread into large tufts, and the other genera may alſo be ſo propagated, though they have beſide a property of increaſing by growth of the ſtalk; which ſeems no other than the property of many of the large plants to creep at the root, and ſhoot out in length greatly from the extremities of their horizontal branches, lying on or under the ground, as thoſe ſpreading parts may more properly be ſo called than roots, the fibres puſhed out from them perpendicularly into the earth being properly the roots; and it is well known that theſe plants, though they propagate themſelves thus by the root, produce ſeeds alſo like the others, by which they may be equally propagated: and this analogy is to be carried yet farther; for as thoſe plants which creep by the roots produce fewer ſeeds than thoſe which are propagated only by ſeeds; ſo the hypna, which are the genus of moſſes in which this growth by the ſtalk is principally obſerved, are very thinly beſet with capſules of ſeed, and many of them produce but very few in a ſeaſon; whereas the brya, and other moſſes which have not this advantage of growing from the ends of the ſtalks, are found every year profuſely covered with capſules from every tuft; nay, there is ſcarce any branch which does not produce its capſule. Now, if theſe capſules contained only a farina capable of impregnating the nodules or the ends of the branches, it is obvious there would be as much of it required for the hypna as for any other kinds of moſſes; but if they are real and perfect ſeeds, it is no wonder that nature has given them profuſely

Muſci. to ſuch kinds as are to be propagated only by ſeeds, and more ſparingly to thoſe which are propagated alſo by the increaſe of the branches.

To this it may finally be added, that the ferns and other epiphylloſpermous plants approach moſt of all others to the nature of the moſſes; and though it has been ſuſpected by many that the fine powder at the back of their leaves was not ſeeds, but only a farina, yet it is now well known that it is true and perfect ſeed; ſince, under many ſpecies of them, there are conſtantly found new and ſelf-ſown plants ariſing in their firſt rudiments of leaves and figure, which have plainly grown from the duſt or powder fallen from the old plants; and as this is now found to be the caſe in regard to the ferns, probably it will alſo appear the ſame in regard to moſſes, when they have been yet farther examined than at preſent. But whether theſe grains of powder have the lobes and radicles by which the ſeeds of larger plants propagate themſelves, or whether they grow into plants like the parent ones, in the manner of the lichens, by mere expanſion, is a thing that requires farther obſervation to determine.

Some of the moſſes, it is evident, approach to the nature of the plants which have their male and female parts in the ſame flower, and others to thoſe which have them in different ones.

After all, this tribe of plants, as well as the muſhrooms, ferns, and ſea-weed, is ſtill imperfectly known. Dillenius, profeſſor of botany at Oxford, was the firſt who attempted an arrangement of them. In his *Catalogus Plantarum circa Giſſam*, publiſhed at Francfort in 1719, and afterwards in his *Hiſtoria Muſcorum*, publiſhed at Oxford in 1741, he divides the moſſes into 16 genera. This arrangement, however, includes the lichens, ſome of the fuci, and other plants which belong to very different families. The work in queſtion is, notwithſtanding, valuable, in having introduced the knowledge of upwards of 200 plants, which were unknown before Dillenius: it is, beſides, of all his works of this kind, the beſt executed, both for the deſcriptions and figures, and ſhould ſerve as a model to ſuch authors as intend to publiſh in detail the hiſtory of any particular family of plants.

Micheli, in a work intitled *Nova Plantarum Genera*, publiſhed at Florence in folio in 1629, divides the moſſes into two ſections, from the figure and ſituation of their flowers. Theſe ſections comprehend together 16 genera, amongſt which are improperly arranged, like thoſe of Dillenius, ſeveral of the lichens and other ſea-weed.

The diſcovery of the ſeeds of the moſſes, though made by Dillenius in 1719, is arrogated by Linnæus to himſelf, who did not begin to write till 1735.

In Ray's method, the moſſes form the third claſs: in Tournefort's, they conſtitute a ſingle genus, by the name of *muſcus*, in the firſt ſection of the 17th claſs, which comprehends the moſſes, muſhrooms, and ſome of the algæ or ſea-weed, and is diſtinguiſhed by the name of *aſpermæ*, or plants without ſeed; the ſeeds of the moſſes not having been detected by Tournefort.

The characteriſtics of theſe plants, according to the ſexual ſyſtem, are, 1. Tops without filaments or threads. 2. The male flower, conſtituted by the preſence of the *antheræ* or tops, placed apart from the female, either on the ſame or diſtinct roots. 3. The female flowers deprived of the *piſtillum* or pointal. 4. The ſeeds devoid of both lobes *(cotyledones)* and proper coverings; ſo that they exhibit the naked embryo Muſci.

In the ſame ſyſtem, theſe plants conſtitute the ſecond order of the claſs *cryptogamia*, which contains all the plants in which the parts of the flower and fruit are wanting, or not conſpicuous. This order is ſubdivided into 13 genera, from the preſence or abſence of the calyx, which in theſe plants is a veil or cover like a monk's cawl, that is placed over the male organs or tops of the ſtamina, and is denominated *calyptra*, from the ſexes of the plants, which bear male and female flowers, ſometimes on the ſame, ſometimes on diſtinct roots; and from the manner of growth of the female flowers, which are ſometimes produced ſingly, ſometimes in bunches or cones. Theſe diſtinctions are moſtly borrowed from Dillenius, whoſe excellence in developing this part of the vegetable kingdom Linnæus very readily acknowledges.

The manner of ſeeding of moſſes in general may be more clearly underſtood from the deſcription of that genus of them which has been traced through all its ſtages, and to which moſt of the others, though every genus has its diſtinct fructification in ſome reſpects, yet bear a very great general analogy.

The genus already obſerved, is that called by Dr Dillenius the *hypnum*. The ſpecies of this are very numerous and common; but that particular one which was the ſubject of theſe obſervations, is the ſhort-branched ſilky kind, common on old walls; and called by that author in his hiſtory *hypnum, vulgare, ſericum, recurvum, capſulis erectis cuſpidatis.*

The head of this moſs appears to the naked eye a ſmall, ſmooth, browniſh-yellow, oblong body, of about a ninth of an inch long; this is covered at its upper end with a membranaceous calyptra or hood, in ſhape reſembling an extinguiſher or a funnel inverted. When this calyptra is taken off, and the head viewed with a microſcope, the ſurface of it is ſeen to be ridged with longitudinal ſtriæ. The baſis of the head is of a deep orange colour, and more opaque than the reſt; and the top is bounded by an orange-coloured ring, ſwelling out ſomething beyond the ſurface of the contiguous parts of the head. Good glaſſes ſhow that in this head there are not wanting the parts eſſential to the fructification of what are uſually called the more perfect plants. This ring is truly a monophyllous undulated calyx, within which ariſe ſixteen pyramidal fimbriated ſtamina; theſe are of a pale greeniſh colour, and are loaded with a whitiſh oval farina. The ſtamina all bend toward each other from their baſes, and almoſt meet in a point at the tops. This is their appearance when the head is nearly ripe; and immediately under the arch formed by theſe ſtamina, is a cylindric hollow piſtillum, through which the farina makes its way, and is diſperſed among the ſeeds in the head; the fruit is a large capſule, filling every part of the membrane which ſhows itſelf on the outſide of the head, and in moſt places is contiguous to it; this capſule is filled with perfect and very beautiful ſeeds; they are round, tranſparent when unripe, but afterwards opaque, and of a very beautiful green, which colour they retain even when dried.

When this head is firſt produced from the plant, the ſtaminæ are very ſlender, and ſtand erect; the head

Muſci, Muſcicapa.

is ſcarce any thicker than the ſtalk, and the calyptra covers it all over, to ſhield the tender ſubſtance of the farina from external injuries. As the farina afterwards ſwells in the ſtamina, the ſeeds in the head increaſe alſo in bulk, and by their increaſe the head is more extended in thickneſs; and the ſtamina are by this means ſeparated farther and farther from each other at their baſes, but bend inwards toward their points, ſo as to form a kind of arched covering over the ſtigma of the piſtillum, which is ſingle; and from hence the farina falls as it ripens into the head, and impregnates the ſeeds.

The 11 principal genera are as follow: *Lycopodium*, *polytricum*, *bryum*, *ſelagines*, *uſneæ*, *mnium*, *byſſi*, *ſphagnum*, *hypna*, *conſervæ*, and *fontinalis*. Theſe are found growing on the barks of trees as well as on the ground. See Plates CCCXXI and CCCXXII.

Moſſes, by the inconſiderate mind, are generally deemed an uſeleſs or inſignificant part of the creation. That they are not, is evident from hence; that He who made them has made nothing in vain, but on the contrary has pronounced all his works to be very good. Many of their uſes we know; that they have many more which we know not, is unqueſtionable, ſince there is probably no one thing in the univerſe of which we dare to aſſert that we know all their uſes. Thus much we are certain of with reſpect to moſſes, that as they flouriſh moſt in winter, and at that time cover the ground with a beautiful green carpet, in many places which would be otherwiſe naked, and when little verdure is elſewhere to be ſeen; ſo at the ſame time they ſhelter and preſerve the ſeeds, roots, gems, and embryo plants of many vegetables, which would otherwiſe periſh; they furniſh materials for birds to build their neſts with; they afford a warm winter's retreat for ſome quadrupeds, ſuch as bears, dormice, and the like, and for numberleſs inſects, which are the food of birds and fiſhes, and theſe again the food or delight of men. Many of them grow on rocks and barren places, and rotting away, afford the firſt principles of vegetation to other plants, which could never elſe have taken root there. Others grow in bogs and marſhes, and by continual increaſe and decay fill up and convert them either into fertile paſtures, or into peat-bogs, the ſource of inexhauſtible fuel to the polar regions.—They are applicable alſo to many domeſtic purpoſes: the lycopodiums are ſome of them uſed in dyeing of yarn, and in medicine; the ſphagnum and polytrichum furniſh convenient beds for the Laplanders; the hypnums are uſed in tiling of houſes, ſtopping crevices in walls, packing up of brittle wares and the roots of plants for diſtant conveyance.—To which may be added, that all in general contribute entertainment and agreeable inſtruction to the contemplative mind of the naturaliſt, at a ſeaſon when few other plants offer themſelves to his view.

Muſci, is likewiſe the name of the 56th order in Linnæus's Fragments of a natural Method. See Botany, p 470.

MUSCICAPA, or Fly-catcher, a genus of birds belonging to the order of paſſeres. The bill is flatted at the baſe, almoſt triangular, notched at the upper mandible, and beſet with briſtles; the toes (generally) divided as far as their origin.

Muſcicapa.

1. The griſola, or ſpotted fly-catcher, is about five inches and three quarters long. The head is large, of a browniſh hue ſpotted obſcurely with black: the back is of a mouſe-colour: the wings and tail are duſky: the breaſt and belly white: the throat and ſides under the wings daſhed with red: the legs and feet are ſhort and black. It is a bird of paſſage; appears here in the ſpring, breeds with us, and departs in September. It builds its neſt againſt any part of a tree that will ſupport it; often in the hollow cauſed by the decay of ſome large limb, hole in a wall, &c. alſo on old poſts and beams of barns; and is found to return to the ſame place ſeaſon after ſeaſon. It lays four or five pale eggs marked with reddiſh. It feeds on inſects, and collects them on the wing. When the young can fly, the old ones withdraw with them into thick woods, where they frolic among the top branches; dropping from the boughs frequently quite perpendicular on the flies that ſport beneath, and riſing again in the ſame direction. It will alſo take its ſtand on the top of ſome ſtake or poſt, from whence it ſprings forth on its prey, returning ſtill to the ſame ſtand, for many times together. They feed alſo on cherries, of which they ſeem very fond.

2. The pondiceriana, Pondicherry or Coromandel fly-catcher, is rather bigger than a ſparrow. The general colour of the upper parts is a cinereous grey; the throat, breaſt, and belly, white; the legs black. It inhabits the coaſt of Coromandel; where, from the agreeableneſs of its ſong, it is called the *Indian nightingale*.

3. The flabellifera, or fan-tailed fly-catcher, is in length ſix inches and a half: the head is black, which colour deſcends on the back part lower than the nape, whence it paſſes forward in a narrow collar to the throat; the chin, throat, and ſides of the neck, except where this collar paſſes, are white; and over the eye is a white ſtreak like an eye-brow: the upper parts of the body are olive-brown; the under parts yellowiſh ruſt, growing whitiſh towards the vent: the tail is longer than the body; the two middle feathers black, the others white: the legs are duſky. This ſpecies inhabits the ſouthern iſle of New Zealand; where it is ſeen conſtantly hunting after inſects, and flies always with its tail in ſhape of a fan. It is eaſily tamed; and will then ſit on any perſon's ſhoulder, and pick off the flies. It has a chirping kind of note; and is called by the natives *Diggo-wagh-wagh*. There is a beautiful figure of this bird in Mr Latham's Synopſis, plate xlix.

4. The caribonenſis, or cat-bird, is ſomewhat bigger than a lark: length eight inches. Bill black: the upper parts of the body and wings are of a deep brown; the under aſh-coloured: the crown of the head is black; the tail is blackiſh; and the legs are brown. This ſpecies is found in Virginia in the ſummer-ſeaſon; where it frequents ſhrubs rather than tall trees, and feeds on inſects: its cry reſembles that of a cat, whence the Engliſh name given it by Cateſby. See Plate CCCXX. fig. 1.

5. The crinita, or creſted fly-catcher, is about the ſize of a lark: the head is creſted, and of a dull green: the hind part of the neck and back are of the ſame colour; the under parts from the chin to the breaſt Fig. 2.

Muſcle. of an aſh-colour, and from thence to the vent yellow: the legs are black. This inhabits Carolina and Virginia in ſummer; builds there, and departs in autumn.

Fig. 3. 6. The rubricollus, purple-throated fly-catcher, is about the ſize of a blackbird: the whole plumage is black; except the chin, throat, and fore part of the neck, on which is a large bed of beautiful crimſon, inclining to purple: the legs are black.—Theſe birds inhabit Cayenne and other parts of South America; where they are found in flocks, and precede in general the toucans in their movements. They feed on fruits and inſects; and are lively birds, always in action. They for the moſt part frequent the woods, like the toucans; and where the firſt are found the others are ſeldom far off.

7. The rubra, or ſummer red-bird of Cateſby, is a moſt beautiful ſpecies, ſomewhat bigger than a ſparrow: the bill is yellowiſh; the eyes are black; the legs duſky: the male is wholly of a ſcarlet colour, except the tips of the quill-feathers, which are of a duſky red: the colour of the female is brown tinged with yellow. It inhabits Carolina and Virginia in the ſummer.

This is a very numerous genus; there being about 90 other ſpecies deſcribed by authors. In the *Syſt. Nat.* (Gmelin), the whole number is 92; in Mr Latham's *Index Ornithologicus*, 97 are enumerated.

MUSCLE, in anatomy. See ANATOMY, Part II. ſect. ii.

The motion of the muſcles of animals has been thought a matter of ſuch curioſity and importance, that an annual lecture upon it was founded by Dr Croone, one of the original members of the Royal Society at London. In conſequence of this, the inveſtigation of the ſubject hath exerciſed the pens of a great number of very learned and ingenious men; notwithſtanding which it ſtill remains involved in almoſt as much obſcurity as ever. Many curious obſervations, however, have been made; and as far as the laws of *dead* mechaniſm can be applied to a *living* machine, the inveſtigators have been ſucceſsful: but ſtill there has been a *ne plus ultra*, a certain barrier by which their inveſtigations have been limited, which no perſon has hitherto been able to paſs, and which it is very improbable ever will be paſſed. To give an account of all the different theories which have appeared on this ſubject is impoſſible; but in the year 1788 a lecture on the ſubject was delivered by Dr Blane, F. R. S. of which, as it ſeems to contain the ſubſtance of all that can be ſaid upon the ſubject, we ſhall here give the following abridgement.

The Doctor conſiders as muſcles not only thoſe large maſſes of fleſh which compoſe ſo great a part of the bulk of the body, but likewiſe all the minuter organs ſubſervient to circulation, nutrition, and ſecretion; ſince not only the heart itſelf, but the whole vaſcular ſyſtem and the inteſtines, owe their action to certain powers of irritability and contractility peculiar to muſcular fibres.

The firſt and moſt obvious conſiderations with reſpect to the muſcles is the regular organization of their fibres in a parallel direction. In this they are diſtinguiſhed from every other matter of a fibrous ſtructure, whether vegetable or mineral, by a certain degree of moiſture, tenacity, and elaſticity, entirely peculiar to themſelves. Muſcle.

The fibres of the muſcles viſible to the naked eye are compoſed of others diſcoverable by glaſſes, and theſe others of fibres ſtill ſmaller; neither hath any perſon been able to diſcover the ultimately fine fibres of a muſcle, which are not compoſed of others. Some have indeed imagined that they have been able to do this, but their obſervations have been found fallacious; and it is now univerſally allowed that the fibres are diviſible beyond what the beſt aſſiſted ſight can trace, and that they are to all appearance uniform. In this regular and fibrous organization they reſemble the cryſtals of ſalts, many of which are found compoſed of fibres more and more fine, and which, like thoſe of the muſcles, can never be ultimately traced.

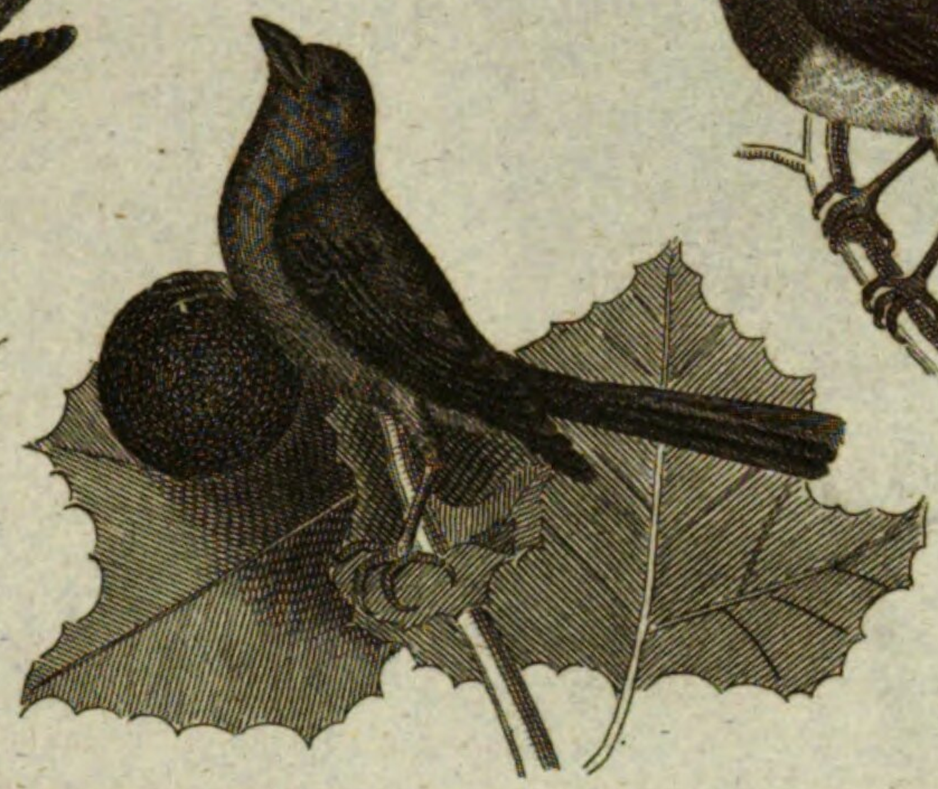
The doctor next touches a little upon the *vis inertiæ* of matter; and, contrary to the generally received opinion of modern philoſophers, conſiders matter as an active ſubſtance. What is called the *vis inertiæ*, he thinks, "is not a reſiſtance of change from reſt to motion, or from motion to reſt, but a reſiſtance to acceleration or retardation, or to change of direction." The activity of matter is further proved by the attractions and repulſions which take place univerſally among its parts; and every inſtance of motion within the cognizance of our ſenſes, may be referred, either in itſelf or its cauſe, to ſome mode of attraction or repulſion. Theſe may both be conſidered as one principle, being both expreſſive of that ſtate of activity originally inherent in matter; and becauſe any two particles, having affinity with each other, muſt either attract or repel, according to their diſtance, their common temperature, and other circumſtances; and it is ſo univerſal an agent in nature, that ſome modern philoſophers have made it abſorb, as it were, every other power and property in matter. It is evident, however, whether this hypotheſis be juſt or not, that the cauſe of muſcular motion cannot be referred to mechaniſm, which is itſelf only a ſecondary principle. Some have had recourſe to a fluid conveyed into the fibres of muſcles, by which they were ſwelled, and thereby ſhortened. One of the moſt plauſible of theſe hypotheſes ſuppoſes this fluid to be the blood: but this is plainly *a petitio principii*; for in order to ſet the blood in motion, muſcular motion is neceſſary. Other fluids have been ſuppoſed to have this effect; but even the exiſtence of theſe has not been proved, and indeed the moſt ſolid objections might be brought againſt all the theories that have hitherto been invented.

Our author having now eſtabliſhed it as a maxim, that the primary properties of matter are attraction and repulſion, and that mechaniſm is only a ſecondary property, he next conſiders muſcular motion as referable to an original law of animated matter, whereby its particles are endowed with an attractive power, for which no cauſe can be aſſigned any more than for gravitation, coheſion, or chemical affinity. If the ſhortening of a muſcular fibre depends on this increaſed power of attraction between its particles, the effect will be to add to the power of coheſion in the fibre; and to determine this the Doctor made the following experiment: Having taken the flexor muſcle of the thumb of a man newly dead while yet warm and flexible,

Muscicapa.

M. Carolinensis.

M. rubra.



M. Crinita.

Musa.

Paradisaica.

Sapientum.

A. Bell Prin. Wal. Sculptor fecit.

Musci, Mosses.

Plate CCCXXI.

Usneæ.

Byssi.

Mnium.

Hypnum.

Sphagnum.

Conferva.

Fontinalis.

A. Bell Print. Mal. Sculptor fecit

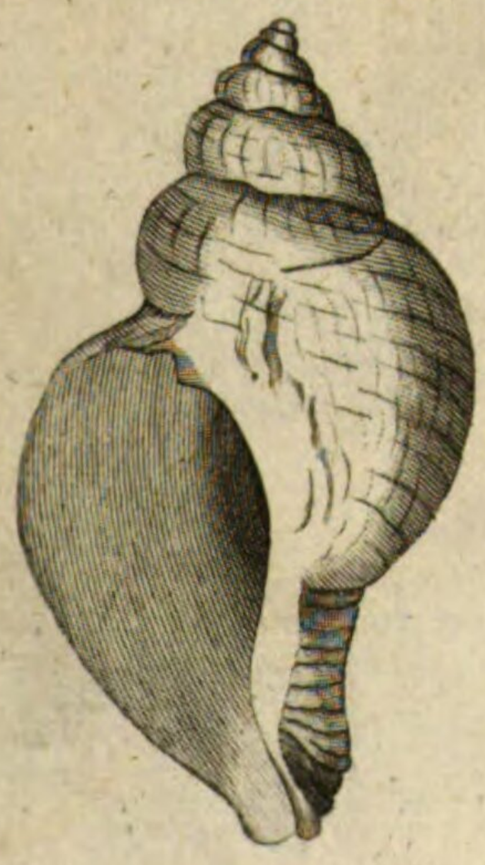
Musci, Moſses.

Lycopodia.

Polytricha. *Brya.* *Selagines.*

Murex.

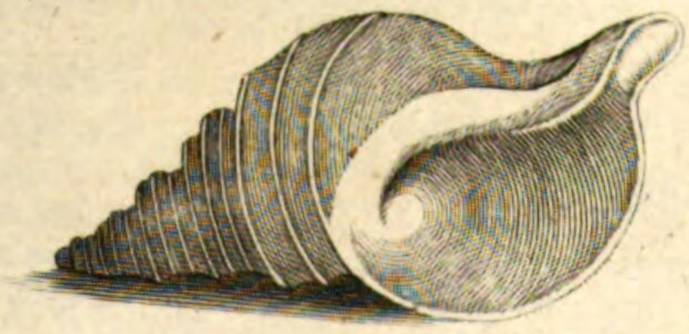
N.o 3.



N.o 4.

N.o 1.

N.o 2.



A. Bell Pinx. Mal. Sculptor fecit.

Muſcle. ible, he appended a weight to it, continually augmenting it until the muſcle broke; and this he found was done when 26 pounds had been added: yet a living man of the ſame apparent ſtrength and age could with eaſe lift a weight of 38 pounds by the exertions of the ſame muſcle. "It is farther in proof of this fact (adds he), that in the caſe of a violent ſtrain from muſcular contraction in the living body, it is the tendon that gives way; whereas we have ſeen that in the dead body the muſcle is the weaker of the two. It is alſo well known, that in caſes of our exertion the muſcular fibres themſelves do not give way, though the ſtrongeſt tendons, ſuch as the tendo Achillis, and even bones, ſuch as the knee-pan, are broke by their living force, which in ſuch inſtances muſt be many times greater than the ſtrength of the dead fibres. There is a caſe related in the Philoſophical Tranſactions by Mr Amyand, wherein the os humeri was broken by an exertion of the muſcles. Every one has heard of fractures happening from very ſlight accidents. Theſe occur moſt probably from a jerk of the muſcles concurring with the external violence. The ſenſible increaſe of hardneſs in a muſcle, when in a ſtate of contraction, may alſo be conſidered as a proof of an increaſed attraction of its particles to each other at that time."

The Doctor next conſiders whether or not a muſcle, when in a ſtate of contraction, undergoes any change of denſity. "Every homogeneous body (ſays he) poſſeſſes a certain degree of denſity, determined by the diſtance of its integrant particles. The moſt common means in nature by which the denſity of ſuch bodies is altered are heat and cold; the one univerſally producing expanſion, the other condenſation. Whether mechanical force has the ſame effects, is a point in natural philoſophy not ſo well aſcertained; for though tenſion and colliſion produce in ſolid elaſtic bodies a change of figure, which they immediately reſume when the force is withdrawn, it has not been inquired whether in ſuch caſes a change of denſity takes place while the body is in a ſtate of elongation or compreſſion. Two elaſtic balls in the act of colliſion undergo a momentary change of figure, ſo that there muſt be an approximation of particles in the direction in which they are flattened; and in the elongation of an elaſtic cord by tenſion there muſt be an increaſed diſtance of the particles in one direction: but while theſe changes take place in one dimenſion of the reſpective bodies, they may be compenſated by contrary changes in the other dimenſions, ſo that the ſeveral bodies may preſerve, upon the whole, the ſame ſolid contents. In order to aſcertain this in the caſe of tenſion, which is the only caſe bearing analogy to muſcular motion, I made the following experiment: I took a piece of the elaſtic gum or *caoutchouck*, three inches ſquare, and about the eighth of an inch in thickneſs; I procured a piece of ſheet tin three inches broad and about ſix inches long, cut into ſharp teeth at each end. The gum was firſt weighed in air, and found to be 380.25 grains. It was then weighed in water along with the tin, to which it was looſely attached, and the weight of both was then 758.75 grains. The gum was then ſtretched upon the tin by means of the teeth at each end to a ſurface of about five inches ſquare, the tin being bent ſo as to leave a free ſpace between it and the gum, in order that when immerſed in water no air-bubbles might be entangled. In this ſituation, the weight of both in water was found to be 746.75 grains. Here was a difference of 12 grains, which could be owing only to a diminution of ſpecific gravity; and in order to be ſure that there was no fallacy nor inaccuracy in the experiment, the gum was immediately diſengaged from one end of the tin ſo as to allow it to ſhrink; and being again weighed in this ſtate in the water, it was found to have recovered exactly its former weight." Muſcle.

From this very remarkable experiment, the Doctor argues to what may probably happen in the contraction of the muſcles. "This point (he ſays) cannot be decided but by an experimental examination. It might be determined whether a muſcle occupies moſt ſpace when relaxed or when contracted, by finding its ſpecific gravity in each of thoſe ſtates by means of the hydroſtatical balance. But this would be found extremely difficult; for the ſtate of contraction is very tranſitory, and the motion itſelf would produce ſuch a diſturbance as would render the reſult unſatisfactory. As there is this obſtacle to an experiment on a living muſcle, it occurred to me that it might be performed on the muſcles of a fiſh which had undergone the operation of *crimping*, as it is called; for in conſequence of dividing the muſcles, by cutting them when alive, they undergo a contraction which continues after death; and upon comparing, by the hydroſtatical balance, portions of muſcle which had been crimped with thoſe of the oppoſite ſide of the ſame fiſh which had on purpoſe been ſaved from this operation, it did not appear that there was any difference in the ſpecific gravity. Two trials were made; one with the maſſeter muſcles of a ſkate, the other with the ſides of a large trout."

To determine whether the contraction or relaxation of a living muſcle made any alteration in its denſity, our author took one half of a living eel, and put it into a glaſs ſtalk, of which the mouth was afterwards fuſed by a blow pipe, and drawn out like the ſtem of a thermometer. The flaſk and tube being then filled with water, our author obſerved, with great attention, whether the convulſive agonies of the creature would make the fluid riſe or fall; but it did neither. The tail part of the eel was made uſe of in this experiment, that there might be no deception from the other, which contained the organs of reſpiration and the air-bladder. In one of his trials, the tail portions of two eels were introduced into the flaſk; but though they were frequently both in convulſions at once, not the leaſt motion of the fluid in the tube could be perceived. On this occaſion alſo the Doctor made ſome experiments to decide the queſtion, Whether the mere circumſtance of *life* made any alteration in the gravity of bodies? His firſt trials were with animals of warm blood incloſed in oil-ſkin and cloſe tin-veſſels; but not being ſatisfied with the accuracy of theſe, from the difficulty of cutting off all communication with the external air, he incloſed live eels in flaſks; and having ſealed them hermetically, he found that the weight of them when alive and dead was the very ſame.

The reſult of all our author's experiments is, that "the contraction of a muſcle produces no change in its denſity, and that animal life differs from inanimate matter in this reſpect, as well as in moſt of its other properties and laws. One purpoſe in nature for muſcles

Muſcle. always preſerving the ſame denſity may be, that as ſome of them act in confined cavities, inconveniences might ariſe from their occupying more ſpace at one time than at another. In the extremities of cruſtaceous animals, for inſtance, which are filled with muſcles, a change of denſity would be apt to burſt them.

"Another circumſtance in which the contractions of muſcles differ from ſimple elaſticity is, that the former, however frequent and violent, does not produce any heat, as colliſion and tenſion are known to do. This may admit of ſome cavil with regard to animals of warm blood; for one of the theories with regard to animal heat is, that it ariſes from the perpetual vibration of muſcular fibres, particularly thoſe of the vaſcular ſyſtem; but this will not hold with reſpect to animals of cold blood, in which the actions of life are equally vigorous. The principal phenomena, therefore, of muſcular motion are, the ſhortening of the fibres, the lateral ſwell, the increaſe of coheſion and hardneſs, and the unchanged denſity and temperature. It would appear from the two laſt circumſtances, that the intimate motions of the particles in relation to one another muſt be different from what take place in the ſeveral inſtances of contraction and expanſion of dead bodies. In the expanſion ariſing from the action of heat and the contraction from cold, the change of denſity ſhows, that in the one caſe the ultimate particles muſt recede from each other, and in the other they muſt approach. The ſame may be ſaid of elaſticity. But as there is no alteration in the denſity of a muſcle in paſſing from relaxation to contraction, this change cannot conſiſt in the approximation of the integrant parts of the fibres, but muſt depend on ſome other circumſtances in the intimate diſpoſitions of the particles. In attempting to conceive in what this conſiſts, the following explanation may be offered. It is probable that the regular ſtructure of ſolid bodies depends on the polarity and ſhape of their integrant parts. Now all bodies, except ſuch as are ſpherical, muſt have a long and a ſhort axis; and let us imagine the fibres of muſcles to be compoſed of ſpheroidal particles, we may then conceive relaxation to conſiſt in their being diſpoſed with their long axis in the line of their fibres, and contraction to conſiſt in their ſhort axis being diſpoſed more or leſs in that direction. This will not only account for the decurtation and uniform denſity, but for the lateral ſwell, and alſo for the increaſed hardneſs and coheſion; for though the particles do not approach or recede, as in bodies ſimply elaſtic, yet their power of attraction will be increaſed by their centres being brought nearer, and by being applied to each other by more oblate ſurfaces. This hypotheſis accords with what has been before proved concerning the unchangeable denſity, for what is loſt in one dimenſion is gained in another; and the cauſe for there being no increaſe in temperature depends probably on the ſame circumſtance by which the denſity is preſerved unaltered."

Thus far the Doctor has proceeded upon a plan, which may become plauſible by means of an hypotheſis at leaſt; but in the proſecution of his ſubject he is involved in the ſame difficulty which has proved too hard for every other perſon, and which he, indeed, does not attempt to ſolve. This is the action of ſtimuli, by which the muſcles are exerted to contraction, and upon which all the phenomena of life depends, and which indeed is the thing that particularly ought to be explained; but of this our author is forced to confeſs his entire ignorance, and to content himſelf with enumerating the ſtimuli of which he cannot explain the action. Stimuli then, according to him, are divided into internal and external. An example of the former kind is the circulation of the blood, which is kept up by an exciting influence of the blood upon the heart and veſſels which contain and impel it. The earlieſt perceivable inſtance of muſcular motion is the beating of the heart, as it is ſeen in the firſt rudiments of the embryo in an egg, and called the *punctum ſaliens*. There ſeems to be eſtabliſhed by nature a certain habitude of action between the veſſels and their fluids; for if a fluid even more mild than the blood, ſuch as milk, be injected into the circulation, it will produce great diſturbance; and if the blood, by being deprived of the influence of reſpirable air, becomes deſtitute of a certain property which it would naturally acquire in the act of reſpiration, it does not prove a ſtimulus to the heart. Muſcle.

In like manner, all the containing parts are accommodated to the nature of their reſpective contents.—The inteſtines are ſo calculated as to have proper motions excited in them by the aliment and the ſecretions which are mixed with it; and there are bodies which, though perfectly mild, ſuch as alimentary ſubſtances of difficult digeſtion, yet excite more violent commotions in the ſtomach than other ſubſtances which are very acrimonious. The various effects of poiſons in different parts of the body may alſo be mentioned as an illuſtration of the peculiar ſuſceptibility of the ſeveral organs of the body. The poiſon of a viper, for inſtance, is perfectly innocent, not only in the receptacles of the animal which produces it, but may be taken into the ſtomach of any animal without the leaſt bad effect, and only exerts its deleterious power when brought in contact with a wounded part. Some vegetable poiſons, on the contrary, ſuch as that of laurel water, prove deadly when taken into the mouth, or applied to any part of the alimentary canal, but are innocent when injected into the veins. It may be remarked alſo, that the receptacles of the ſeveral ſecreted fluids, ſuch as the gall-bladder and bladder of urine, are ſo adapted to their natural contents, by a due meaſure of irritability, as to bear their accumulation to a certain degree, and then to expel them. We have here alſo a proof that irritability is not in proportion to ſenſibility; for both theſe receptacles are extremely ſenſible to pain and irritation from extraneous acrimony, though ſo moderately ſenſible to the acrimony of their natural contents. This diſpoſition in the ſeveral organs to perform their natural functions, in conſequence of the ſtimulus of the reſpective fluids they contain, has aptly enough been called the natural perception of theſe organs.

Our author now conſidering that the internal organs are calculated to perform their functions in conſequence of certain ſtimuli, concludes the application of chemical and mechanical ſtimuli is not a mode of experiment likely to produce uſeful knowledge; and hence, he thinks, we may ſuggeſt the moſt likely means of reſtoring loſt irritability and action to the vital functions, when ſuſpended by ſuffocation, ſtrangulation, or immerſion. In theſe caſes, he ſays, that all other means are far inferior to that of inflating the lungs

Muſcle. with atmoſpheric air, and ſtroking and preſſing the ribs in ſuch a manner as to imitate natural reſpiration. The only other thing which he ſuppoſes to be any way uſeful, is the application of heat to ſuch as have been immerſed in cold water; but of cool air to thoſe who have ſuffered from mephitic vapours.

The Doctor having then conſidered ſome other parts of the animal economy, enters into an inveſtigation of the analogy between motion and ſenſation. "This analogy (ſays he) is the more exact, that the nerves ſeem to be the inſtruments of both; for not only the organs of ſenſation and voluntary motion, but thoſe of involuntary motion, are ſupplied with nerves, and dependant upon them; for if the influence of the nerves leading to the heart or inteſtines is interrupted by cutting, ligature, or palſy, the function of theſe parts is thereby deſtroyed. Thus, as there is a peculiar ſenſibility belonging to the ſeveral ſenſes, ſo is there a peculiar irritability belonging to the ſeveral organs of motion. The intention of nature, therefore, in diſtinguiſhing nerves to every muſcular organ, was probably in order to conſtitute thoſe peculiar perceptions on which the various vital and natural functions depend. But I give this only as a conjecture; and though the nervous influence may thus *modify* irritability, there is reaſon to think that it does not *beſtow* it."

Our author controverts the principle which has been held by ſome very able phyſiologiſts, that all muſcular irritability depends upon a ſentient principle. "There have been ſeveral inſtances (ſays he) of the production of fœtuſes without the brain; and a principal fact in ſupport of this opinion is, the exiſtence of animals without brain or nerves. That there are ſuch, was, I believe, firſt obſerved by Haller, and has been confirmed by Mr Hunter; who maintains farther, that the ſtomach is a centre or ſeat of life more eſſential to it than the brain. That the ſtomach ſhould be an organ of ſo much conſequence, ſeems natural enough from the importance of its function, which is that of aſſimilation; and life can be more immediately and completely extinguiſhed by an injury to it, ſuch as a blow, than by the ſame violence to any other part of the body. It is alſo well known, that the muſcular fibres of animals endowed with a nervous ſyſtem, will retain their irritability for ſome time after their ſeparation from the brain and nerves.—It is evident likewiſe, from the phenomena of vegetation, that irritability may exiſt in nature without ſenſation, conſciouſneſs, or any ſuſpicion of the exiſtence of a nervous ſyſtem. In favour of this opinion, it is farther obſervable, that thoſe animals which are deſtitute of brain and nerves are of the claſs of *vermes*, the moſt ſimple in nature, having only one function, viz. that of aſſimilation; and therefore not requiring that variety of action, and thoſe perceptions which are peculiar to more complex animals. Laſtly, the ſtate of an egg before incubation, and the condition of thoſe animals which become torpid from cold, and afterwards revive, afford facts which favour this opinion; as they ſhow that there is a certain principle of ſelf-preſervation, independent not only of the operation of the nervous ſyſtem, but even of the circulation; for in this quieſcent ſtate, thoſe portions of animal matter are preſerved for a great length of time from that corruption to which they would otherwiſe be liable, and their fluids are prevented from freezing in a degree of cold which would congeal them, were they deſtitute of every principle of life." Muſcle.

In the courſe of his reaſoning, our author conſiders the nervous ſyſtem not only as a mere appendage to life, but as tending to impede its operation, and ſhorten its exiſtence. "Simple life (adds he) will not only ſurvive ſenſation, but will ſurvive it longer, if the animal is killed by deſtroying the nervous ſyſtem, than if it had been deſtroyed by hæmorrhagy, ſuffocation, or other violence. If a fiſh, immediately upon being taken out of the water, be ſtunned by a violent blow on the head, or by having the head cruſhed, the irritability and ſweetneſs of the muſcles will be preſerved much longer than if it had been allowed to die with the organs of ſenſe entire. This is ſo well known to fiſhermen, that they put it in practice in order to make them longer ſuſceptible of the operation called *crimping*. A ſalmon is one of the fiſhes leaſt tenacious of life, inſomuch that it will loſe all ſigns of life in leſs than half an hour after it is taken out of the water, if ſuffered to die without any farther injury; but if, immediately after being caught, it receives a violent blow on the head, the muſcles will ſhow viſible irritability for more than 12 hours afterwards."

To the ſame purpoſe, our author obſerves, that in warm-blooded animals an exceſſive exertion of voluntary motion immediately before death, prevents the muſcles from being rigid when cold, and renders them more prone to putrefaction. Thus, if an ox is killed immediately after being overdrove, the carcaſe will not become ſtiff when it grows cold, nor is it capable of being preſerved by means of ſalt. In confirmation of the ſame hypotheſis alſo, our author obſerves, that in ſome diſorders of the brain, ſuch as hydrocephalus, and apoplectic palſy, in which the functions of the brain are ſuſpended, the office of digeſtion is ſometimes better performed than in health.

From all this our author concludes, along with Mr Hunter, that the exerciſe of ſenſation is inimical to life, and that a ſort of fatigue is induced by this as well as by voluntary motion; "ſo that all that intercourſe carried on through the nerves, whether *towards* the brain in the caſe of ſenſation, or *from* the brain in acts of volition, tends to wear out the animal powers. And, as intenſe and long-continued thought, though not terminating in any outward action, tends alſo to produce an inability for farther exertions, it would appear that the brain or ſenſorium is more particularly the organ which is ſubject to that ſpecies of ſufferance called *fatigue*. From theſe facts we perceive the neceſſity of ſleep, which conſiſts in a temporary ſuſpenſion of ſenſation, volition, and thought, and is a reſource of nature, whereby the powers of life recover themſelves after ſatiety and fatigue, which are provided as guards to warn us when nature is in danger of being ſtrained, either by repletion or overexertion; and it is evident that ſuch barriers were abſolutely neceſſary, in order to ſet bounds to operations which are only occaſionally requiſite, and which would otherwiſe depend on the caprice of the will. The exerciſe of ſenſation and voluntary motion in a moderate degree is conformable to the intention of nature, and therefore ſalutary; and it is only when they are exceſſive

Muſcle ceſſive that they tend to wear out the powers of life, and more eſpecially if theſe are not duly recruited by ſleep. It follows, from the ſame principle, that when life is threatened by certain diſeaſes, of which the chief ſymptom is irritation, any means by which ſenſation, whether natural or morbid, and muſcular motion, whether voluntary or involuntary, convulſive or ſpaſmodic, can be ſoothed or ſuſpended, will prove ſalutary, by allowing the powers of life to rally as it were, and to recover themſelves. In this conſiſts the operation of narcotic medicines, ſuch as opium;—which, in complaints both of a general and local nature, proves uſeful, not merely as a palliative by the removal of temporary pain or ſpaſm, or by procuring ſleep, but as a principal inſtrument of recovery, by allowing the powers of life to exert their natural action, in conſequence of the removal of irritation."

In treating this ſubject, the Doctor conſiders the effects of opium as affecting ſimple or ſenſitive life; and to determine this, he made the following experiments: Having made a ſolution of opium in water, he put into one portion of it ſome ſound living eels, and others with their heads bruiſed; and in a number of trials it was found that the ſound eels generally died much ſooner than the bruiſed ones. This, however was the caſe only when the ſolution was of a certain degree of ſtrength, ſuch as half a grain of opium at leaſt to an ounce of water; for when only about half this ſtrength, the ſound eels lived much longer, the time being then protracted to that in which the bruiſed eels would have died merely in conſequence of their injury; but it muſt be obſerved, that even the wounded eels died conſiderably ſooner than when put into plain water.

From all this, our author concludes, that "the great maſſes of muſcle in the trunk and extremities of the body are the inſtruments of the mind in acting upon external bodies; and we may therefore rank in the liſt of ſtimuli the nervous power by which the will and the paſſions excite external motions. This is a function ſufficiently important for the nerves, without admitting them as the principle on which irritability depends."

Having diſclaimed all inquiry into the connection between muſcular motion and volition, the Doctor proceeds to conſider the effects of the different paſſions upon the muſcles. Though theſe are diſtinct from the motions directly produced by the will, yet he conſiders them among thoſe ariſing from conſciouſneſs; "for there are emotions of the heart which have viſible and powerful effects upon the mind and vaſcular ſyſtem, which are organs entirely out of the reach of the will. Not to mention the well-known effects of grief, fear, and joy, which affect the whole circulation, there are certain paſſions and ſentiments which produce partial and local effects. Theſe are eſtabliſhed by nature, either to anſwer ſome important purpoſe in nature, as in the caſe of the congeſtion of the fluids in the parts of generation in conſequence of the venereal appetite, or to ſerve as natural expreſſions, as in the caſe of bluſhing or weeping. One of the moſt ſtriking effects of the paſſions upon muſcular action, is the influence they have upon the ſtrength or mechanical force of the voluntary muſcles. Fear produces debility almoſt amounting to palſy. Courage and order of mind, on the contrary, add to the natural ſtrength. When the mind is agitated by ſome intereſting object, and calls upon the body for an extraordinary exertion to effect its end, the muſcles are thereby enabled, as it were by magic, to perform acts of ſtrength of which they would be entirely incapable in cold-blood. In circumſtances of danger, for inſtance, where life or honour are at ſtake, exertions are made for overcoming mechanical reſiſtance which ſeem incredible, and would be impoſſible, were not the mind in a ſort of phrenzy; and it is truly admirable in the economy of nature, that an idea in the mind ſhould thus in a moment augment the powers of motion, and inſpire additional reſources of ſtrength adequate to the occaſional calls of life. The great increaſe of ſtrength in maniacs is alſo referable to the paſſions of the mind. Theſe conſiderations would almoſt lead us to doubt whether or not the accounts we have of the great feats of ſtrength aſcribed to individuals in the heroic ages be fabulous or not. It is alſo worthy of remark, that, in great and laſting exertions of ſtrength to which men are impelled by active and generous affections, fatigue is not induced in the ſame proportion by many degrees as by the ſame quantity of muſcular action in the cool and deliberate actions of common life." Muſcles.

Having thus diſcuſſed the ſubject of *internal* ſtimuli, our author next proceeds to take notice of the ſecond claſs, viz. ſuch as are *external*. Theſe are either immediate or remote, viz. ſuch as are excited by mechanical means, or by acrimony directly and artificially applied to a muſcular fibre; or ſuch as occur in the inſtances of ſympathy, and in the caſe of thoſe inſtincts which nature has inſtituted for the purpoſe of ſelf-preſervation in brutes, and in the early part of human life. "There are certain habitudes (ſays he) between outward ſtimuli and the moving powers whereby natural propenſities are conſtituted, equally neceſſary to the ſupport of life as the internal functions. Thus, in a new born animal, the firſt contact of the external air excites the act of reſpiration, and the contact of the nipple excites the act of ſucking; both of which actions are abſolutely neceſſary to the maintenance of life, and require the nice co-operation of a great number of muſcles prior to all experience. Actions of this kind are called *inſtinctive*; but though different from thoſe of voluntary motion, they nevertheleſs run into one another; ſo that what was at firſt merely inſtinctive, may afterwards become a matter of deliberate choice. The ſame muſcles are the inſtruments of both; and they differ from the muſcles obeying the internal ſtimuli, ſuch as the heart, in being liable to fatigue, and thereby concurring with the exerciſe of ſenſation and of thought, in rendering ſleep neceſſary. There are no muſcles except thoſe of reſpiration, of which the conſtant action is neceſſary to life, and which are void of conſciouſneſs in their ordinary exerciſe, but which are yet in ſome meaſure under the controul of the will. The principal end anſwered by this power of the will over the muſcles of reſpiration in man, is to form and regulate the voice. But, though inſtinctive motions are in ſome caſes convertible into thoſe which are voluntary, they ought by no means to be confounded together; for even thoſe animals which are deſtitute of brain and nerves, are capable of actions evidently of the inſtinctive kind.—

A leech

Muſcle.

A leech, for inſtance, being brought into contact with a living animal, is impelled by an inſtinct of its nature to faſten upon it, and ſuck its blood. There is ſomething very ſimilar to this even in vegetables, as in the caſe of tendrils and creeping plants being ſtimulated by the contact of other bodies to cling round them in a particular direction ‡.

‡ See *Vegetable Motion.*

Beſides theſe obſervations on the inferior animals, our author brings ſome experiments to ſhow, that inſtinctive actions, even in animals furniſhed with a brain and nerves, do not depend on ſenſation. Having divided the ſpinal marrow of a live kitten a few days old, he irritated the hind-paws by touching them with a hot wire. By this the muſcles of the poſterior extremities were thrown into contractions, ſo as to produce the motion of ſhrinking from the injury; and the ſame effects were obſerved in another kitten of which the head was entirely ſeparated from the body. In repeating this experiment he found, that when the ſpinal marrow was cut through between the lumbar vertebræ and os ſacrum, the poſterior extremities loſt their irritability, but the tail reſumed it. Even the head retained its irritability after it was cut off; as appeared by touching the ears with a hot wire, or by pricking them: "and (ſays our author) as the extremities are alſo irritable, it will not be ſaid that conſciouſneſs and ſenſation exiſt in two ſeparated portions of the body."

The effects of habit are then conſidered: and the concluſion from the doctor's reaſoning upon this ſubject is, that "there is a *co-ordinance*, or pre-eſtabliſhed harmony, as it were, between the faculties of animals and the laws of external matter, which is the foundation of all the inſtinctive habits of animals, as well as the rational conduct of man."

To the law of habit have been referred the effects of certain contagions, ſuch as that of the ſmall-pox, which do not produce their effect more than once in life. With reſpect to this he obſerves, "that upon whatever principle this property of the animal economy depends, it is an undoubted fact, that theſe morbid poiſons, after exciting a certain degree of diſturbance, and a certain ſeries of diſeaſed actions, no longer make any impreſſion on the powers of life, otherwiſe there could be no ſuch thing as recovery: for at the time in which a perſon begins to recover from the ſmall-pox, the poiſon actually preſent in the circulating ſyſtem is multiplied infinitely beyond what it was when it excited the diſeaſe. The conſtitution has therefore at that time, with reſpect to this acrimony, acquired an inſenſibility, or rather want of irritability; and this it preſerves ever afterwards. This, however, holds only with regard to thoſe morbid poiſons which excite febrile affections, and ſeems to be a neceſſary proviſion of nature to guard againſt ſuch noxious principles as are generated within the body itſelf."

Having laſtly conſidered the effects of *irritation* upon the human body, the Doctor goes on to conſider a very remarkable property of living muſcles, viz. that of their being in a conſtant ſtate of tenſion, more or leſs, independent of any temporary ſtimulus. This is evident from what happens when any muſcle is cut; for then there is an immediate retraction of the ſeparated parts; and that this is their natural ſtate is farther proved by the ſpontaneous motion which takes place in conſequence of the relaxation of an antagoniſt muſcle, as when the mouth is drawn to one ſide in conſequence of hemiplegia. Some degree of tenſion indeed is neceſſary for the performance of the natural motions of the muſcles, whether voluntary or involuntary; and the vigour with which the ſeveral actions are performed depends on the due degree of this tone.

Muſcle.

This tone of the muſcles is every where maintained by a certain counteracting mechanical power: the great muſcles are kept on the ſtretch by the bones, the heart and veſſels by the maſs of fluids, and the inteſtines by the aliments taken in, and their other contents. Diſeaſes of various kinds may ariſe from the different degrees of this tenſion, and the vaſcular ſyſtem is more apt to be affected by different degrees of tenſion than any other part of the body; and our author conſiders what is called a *nervous* habit as one of the effects of want of tenſion. He likewiſe attributes to the different degrees of tenſion, more than to any thing elſe, the great difference of conſtitutions obſervable among mankind. He obſerves alſo, that the tenſion of the muſcles is greatly affected by ſympathy. "This (ſays he) is particularly obſerved in the blood-veſſels and inteſtines; for a relaxation in theſe will produce a like affection in every other part of the animal ſyſtem. With regard to the inteſtines, it may be mentioned among other proofs, that it is common for perſons in a ſtate of great weakneſs to be affected by ſyncope, and even inſtantaneous death, in the act of evacuating the bowels. It ſeems to be from a like cauſe that a temporary lowneſs is produced by an abſceſs being opened.

The Doctor concludes his ſubject with conſidering the muſcles as mechanical powers. "As they conſtitute the ſtrength of animals, it may be proper to conſider the relation of their ſtrength to their bulk, and the relation of the bulk and ſtrength of the body to the denſity and coheſion of its own materials; and to the bulk, denſity, and coheſion of the external inanimate bodies with which it is converſant.

"It has been demonſtrated by Galileo, that in ſimilar unequal bodies, of a cylindrical or priſmatic ſhape, ſuch as the limbs of animals nearly are, the ratio of their efforts to break by their own weight is in the quadruplicate ratio of their lengths; but that the reſiſtance they make to the ſame force is only in the triplicate ratio of their lengths. It follows from this, that in order to endow the limbs of animals with the ſame relative force, it is not only neceſſary that the bones ſhould poſſeſs an increaſed proportion of thickneſs, in order to give an adequate increaſe of what may be called the dead ſtrength; but a ſimilar increaſe of living ſtrength is neceſſary, by a ſuitable addition of muſcular power, in order to keep pace with the increaſed ſize of the bones. Now we obſerve, in fact, that in the large-ſized animals, ſuch as the bull and the elephant, the thickneſs both of their bones and muſcles becomes greater in proportion to the length of their limbs than in the ſmaller animals, and they are therefore of a leſs elegant form. But nature has not carried this ſo far as to compenſate for the diſadvantage ariſing from the increaſe of ſize; for the greater animals have not the ſame proportional ſtrength, in relation to their bulk, that the ſmaller animals have. It has been computed that a flea can draw from 70

to

Muſcle. to 80 times its own weight, whereas a horſe cannot with eaſe draw more than three times his own weight. This diſproportion between ſize and ſtrength is very obſervable in different individuals of the human ſpecies; for tall men are not muſcular, even in the ſimple proportion of their ſtature."

Our author now proceeds to aſſign ſome reaſons why the ſtature of mankind in general is not larger than we ſee it. Some obſervations upon this ſubject are made under the article GIANT, where it is attempted to ſhow, that by increaſing the proportional ſtrength of the materials, the ſize of the human body might have been augmented in any proportion. To this, however, the Doctor replies, that "had the bones been harder, they would not have been calculated for the common duration of life, the effect of which being to increaſe their hardneſs and dryneſs, they muſt be endowed originally with a certain degree of ſoftneſs and ſucculence: and, with regard to muſcles, a degree of hardneſs much greater than they poſſeſs would have been incompatible with their contractility." But this reaſoning does not ſeem to be concluſive. The bones of a lion are ſaid to be much harder than thoſe of any other animal; yet we do not find that theſe creatures are liable to any kind of diſeaſe in conſequence of this ſuperior hardneſs. Neither is any inconvenient degree of hardneſs in the muſcles a neceſſary conſequence of their increaſed ſtrength; for ſilk, though equally ſoft and flexible, nay much more ſo than hemp or flax, is nevertheleſs much ſtronger; and we cannot by any means doubt, that if men had formerly been of a larger ſtature than they are at preſent, the materials of their bones and muſcles might have been proportionably ſtronger, without the leaſt injury or impediment to any of the operations of life.

When we conſider the manner in which the muſcles act upon the bones into which they are inſerted, we may be apt to think that nature has been very prodigal of mechanical power; for, conſidering the bones as levers, the muſcles act upon them at a very great diſadvantage, being always inſerted much nearer the fulcrum than the weight to be raiſed. Thus the two muſcles of the arm, named *biceps* and *brachiæus internus*, in order to ſupport in the hand a weight of one pound with the fore-arm at right angles to the humerus, muſt exert a power equal to ten pounds. Another circumſtance alſo which tends to waſte the power, is the obliquity with which they are inſerted into their bones; ſo that the greater part of the force is expended in preſſing one bone againſt another at the articulation, and only a ſmall part of it in making the flexures and extenſions. Theſe diſadvantages, however, are compenſated by a number of conveniences which could not have been obtained on any other plan. We muſt diſtinguiſh between thoſe actions which conſiſt in preſſure and thoſe which depend on percuſſion; for as the momentum of this laſt depends on velocity, it is evident that there muſt be a great advantage from the inſertion of the tendon being near the centre of motion, as greater velocity with leſs expence of contraction will thus be communicated to the extremity. The muſcles, for inſtance, which are attached to the *olecranon*, in performing thoſe actions with the hand which require rubbing, act with a diſadvantage exactly proportional to the inequality of the diſtance from their inſertion to the joint of the elbow, and that from the ſame joint to the hand. This is an act of preſſure. But in the caſe of percuſſion, as in the action of uſing a hammer, there is an evident advantage reſulting from the velocity communicated to the extremity; for, in order to have produced the ſame velocity, with the inſertion at a greater diſtance from the centre of motion, a much greater degree of contraction would have been neceſſary; and our author ſhows that fatigue principally depends on a contraction of the muſcles. "If any one (ſays he) will take the trouble of comparing the fatigue of the biceps muſcle, in bearing a weight in the hand with the elbow-joint bent to a right angle, with that of bearing the ſame weight for the ſame length of time with the joint at an acute angle, he will be ſenſible how much the degree of fatigue depends on the extent of contraction; and, by attending to the relative ſituation of muſcular fibres, it will appear, that Nature, in diſtributing the fibres of muſcles obliquely, has had it in view not only to increaſe their number, but to ſave contraction." Muſcle.

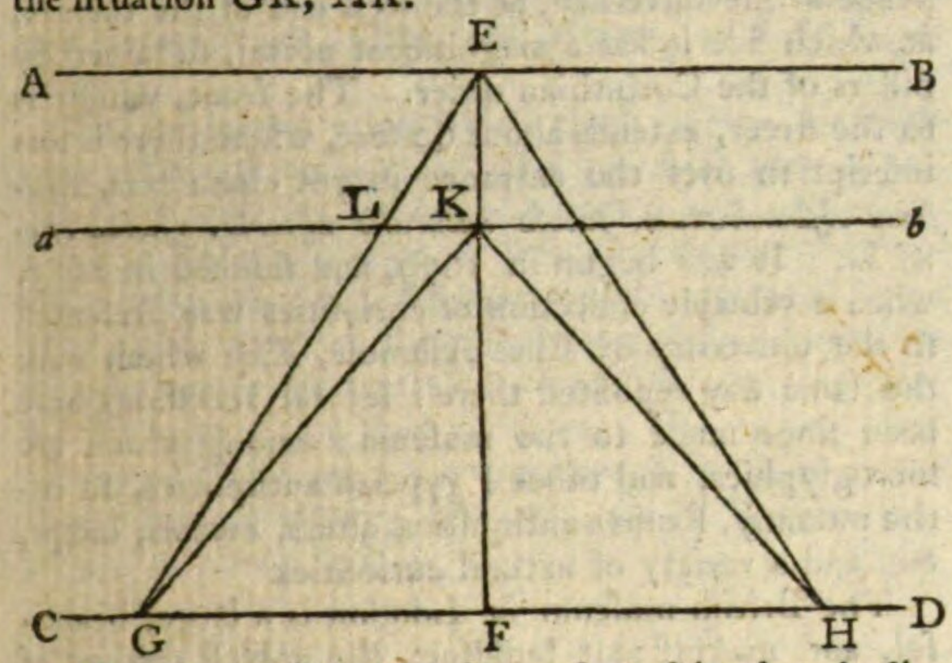
In conſidering the actions of the various muſcles in producing the different actions of the body, we find ſcarce one produced that can be called direct. In ſome inſtances we find two muſcles, or two ſets of muſcles, co-operating, ſo that the motion effected by them ſhall be in the diagonal of their direction. This is the caſe of the oblique muſcles of the abdomen in ſome of their actions, and of the intercoſtal muſcles in all theirs. Sometimes different portions of the ſame muſcle combine in like manner to produce a ſimilar effect; and in all the long muſcles, however ſimple their origin and inſertion may be, there is an internal obliquity of their fibres with regard to one another; for theſe do not run from end to end, but there are parts of the tendon running into the belly of the muſcle, ſo as to divide it into penniform and rhomboidal portions. This diſtribution of the fibres takes off from the length; but as it takes place in thoſe caſes where the origin and inſertion are at a conſiderable diſtance, this can be afforded: and this, as well as the waſte of power, in conſequence of oblique action, is more than compenſated by the increaſed ſtrength from the fibres being multiplied; for, in conſequence of this ſtructure, there is an extent of tendon afforded ſufficient for the inſertion of a greater number of fleſhy fibres.

The Doctor illuſtrates this principle in the mechaniſm of muſcular action from the example of fiſh; a ſpecies of animals which exert greater muſcular powers than any others. "The muſcles of moſt fiſh (ſays he) conſiſt of regular ſeries of oblique ſhort fibres, forming thoſe ſtrata which every one muſt have obſerved in their muſcular ſubſtance. Their motions are more ſimple and limited than thoſe of land-animals, but much more vigorous; for a fiſh in the ſea has to make its way through a medium about 1000 times more denſe than air, and with more rapidity than thoſe which inhabit the land. Nature, therefore, inſtead of giving them muſcles whoſe fibres would run ſtraight from one end of their body to the other, has multiplied their numbers, by diſtributing them into ſhort and oblique portions. I have ſeen the ſword of a ſword-fiſh ſticking in a plank, which it had penetrated from ſide to ſide; and when it is conſidered

that

Muſcle. that the animal was then moving through ſo denſe a medium, and in the ſame direction with the ſhip, we muſt form a high conception of its muſcular power."

Laſtly, our author gives a mathematical demonſtration, that by the obliquity of the muſcles a very conſiderable quantity of contraction is ſaved, and conſequently a proportional degree of fatigue prevented.—"Let the line AB (ſays he) in the annexed diagram, repreſent a moveable bone, and the line CD a fixed bone parallel to it. Let FE, perpendicular to theſe lines, repreſent a muſcle acting in its own direction, and the lines GE, HE, repreſent two muſcles acting obliquely, and producing by a diagonal action the ſame effect as the other. If the bone AB be brought to the ſituation *a b* by the action of the muſcle FE, the muſcle will then be in the ſituation FK. If the bone is brought into the ſame ſituation by the action of the muſcles GE, HE, theſe muſcles will then be in the ſituation GK, HK.



"The propoſition to be demonſtrated is, that the line GK bears a greater proportion to the line GE, than the line FK does to line FE; for FK is to FE as GL is to GE (Eue. Elem. B. vi. Prop. 2.); and the angle ELK being leſs than a right angle, the angle GLK, which is adjacent to it, muſt be greater than a right angle; and the angle GKL being in the ſame triangle with GLK, muſt be leſs than a right angle. The line GK, therefore, which ſubtends the greater angle, is greater than the line GL, ſubtending the leſſer, and therefore bears a greater proportion to GE. But the line GL is to GE as FK is to FE; and therefore GK bears a greater proportion to GE than FK does to FE; that is, the fibres of the muſcles acting obliquely, ſuffer a leſs proportional decurtation than thoſe of the muſcle acting directly.

"It is farther obvious, that the more oblique the action becomes, the greater ſaving there will be of contraction; for in moving the line *a b* towards CD, the line FK diminiſhes in a ſwifter ratio than the line GK; and when the former has vaniſhed, the latter is in the ſituation GF."

Beſides theſe advantages in point of diminiſhing fatigue, there are others relating to the ſhape of the members. Thus, if the inſertions of the muſcles had been at a great diſtance from the joints, they muſt upon every occaſion have paſſed like bow-ſtrings from one bow to the other, and the limbs muſt have been exceedingly clumſy and unwieldy; all the motions muſt alſo have been extremely ſlow: and notwithſtanding the ſuperior ſtrength which people would then have enjoyed, it is very plain that they would ſcarce have been fit for any of the offices of life which they now perform. Muſcle || Muſes.

Muscle, in zoology. See Mytulus.

MUSCOVY. See Russia.

Muscovy-Glaſs, or Glimmer. See Mica.

MUSCULUS, a military machine, made uſe of by the Romans to cover and protect the ſoldiers while they approached and undermined the walls of beſieged places, or filled the ditches. It ſeems to have reſembled the teſtudo in form, but was ſmaller in ſize. See Testudo.

MUSEIA, were Grecian feſtivals in honour of the Muſes, celebrated with games every fifth year, particularly by the Theſpians. The Macedonians alſo obſerved a feſtival of the ſame name in honour of Jupiter and the Muſes, which laſted for nine days, and was celebrated with ſtage plays, ſongs, and poetical compoſitions.

MUSES, certain fabulous deities among the Pagans, ſuppoſed to preſide over the arts and ſciences: for this reaſon it is uſual for the poets, at the beginning of a poem, to invoke theſe goddeſſes to their aid.

The muſes were originally only ſingers and muſicians in the ſervice of Oſiris, or the great Egyptian Bacchus, under the inſtruction and guidance of his ſon Orus; but in ſucceeding times they were called the *daughters of Jupiter and Mnemoſyne* or *Memory*.

Theſe are the only pagan divinities whoſe worſhip has been continued through all ſucceeding changes in the religion and ſentiments of mankind. Profeſſors of every liberal art in all the countries of Europe ſtill revere them; particularly the poets, who ſeldom undertake the ſlighteſt work without invoking their aid.

Sir Iſaac Newton tells us, that the ſinging women of Oſiris were celebrated in Thrace by the name of the *Muſes*; and that the daughters of Pierius, a Thracian, imitating them, were celebrated by the ſame name.

Diodorus Siculus informs us, that Alcman of Meſſene, a lyric poet who flouriſhed in the 27th Olympiad, 670 years B. C. makes them the daughters of Uranus and Terra. It has been aſſerted by ſome ancient writers, that at firſt they were only three in number; but Homer, Heſiod, and other profound mythologiſts, admit of nine (A).

In his hymn to Apollo, Homer ſays,

——By turns the *nine* delight to ſing.

And Heſiod, in his theogony, names them all.—They are ſaid ſeverally to preſide over ſome art or ſcience, as muſic, poetry, dancing, aſtronomy. By ſome they are called *virgins*, becauſe the virtues of education appear unalterable: they are called *muſes* from a Greek word which ſignifies to explain myſteries, becauſe they have taught things the moſt curious and *Burney's Hiſt. of Muſic.*

(A) It has been ſaid, that when the citizens of Sicyon directed three ſkilful ſtatuaries to make each of them ſtatues of the three Muſes, they were all ſo well executed, that they did not know which to chooſe, but erected all the nine, and that Heſiod and Homer only gave them names.

Muſes. and important to know, and which are above the comprehenſion of vulgar minds. Each of their names is ſaid to include ſome particular allegory; *Clio*, for inſtance, has been thus called, becauſe thoſe who are praiſed in verſe acquire immortal fame; *Euterpe*, on account of the pleaſure accruing to thoſe who hear learned poetry; *Thalia* implies for ever flouriſhing; *Melpomene*, that her melody inſinuates itſelf into the inmoſt receſſes of the ſoul; *Terpſichore* marks the pleaſure which thoſe receive who are verſed in the liberal arts; *Erato* ſeems to indicate, that the learned command the eſteem and friendſhip of all mankind; *Polyphymnia*, that many poets are become immortal by the number of hymns which they have addreſſed to the gods; *Urania*, that thoſe whom ſhe inſtructs elevate their contemplations and celebrity to the heavens and the ſtars; and laſtly, the exquiſite voice of *Calliope* has acquired her that appellation, as the inventreſs and guardian of eloquence and rhetoric.

An epigram of Callimachus gives the attributes of the muſes in as many lines.

Calliope the deeds of heroes ſings;
Great *Clio* ſweeps to hiſtory the ſtrings;
Euterpe teaches mimes their ſilent ſhow;
Melpomene preſides o'er ſcenes of wo;
Terpſichore the flute's ſoft pow'r diſplays;
And *Erato* gives hymns the gods to praiſe;
Polymnia's ſkill inſpires melodious ſtrains;
Urania wiſe, the ſtarry courſe explains;
And gay *Thalia's* glaſs points out where folly reigns.

This epigram does not, however, exactly correſpond with the ideas of other poets, or of the ancient painters, in characteriſing the attributes of the muſes. The ancients had numberleſs ingenious and fanciful ideas concerning the muſes, which we have not room to recite.—"It ſeems (ſays the Abbe Barthelemi*) as if the firſt poets, enchanted with the beauties of nature, occaſionally were led to invoke the nymphs of the woods, hills, and fountains; and that yielding to the prevailing taſte for allegory, they gave them names relative to the influence they might be ſuppoſed to have over the productions of the mind. At firſt three muſes only were admitted, Melete, Mneme, and Aœde: that is to ſay, the meditation or reflection neceſſary to ſtudy; memory which records illuſtrious deeds; and ſong which accompanies their recital. In proportion as improvement was made in the art of verſification, its characters and effects were perſonified, the number of the muſes increaſed, and the names they now received referred to the charms of poetry, its celeſtial origin, the beauty of its language, the pleaſure and gaiety it inſpires, the ſong and dance which add to it new charms, and the glory with which it is crowned. Afterwards were aſſociated with them the Graces, whoſe employment it is to embelliſh poetry, and Love who is ſo frequently its object. Theſe ideas took birth in a barbarous country, in Thrace, where Orpheus, Linus, and their diſciples, ſuddenly appeared in the midſt of ignorance. The muſes were honoured there on the Pierian mount, and extending their dominion, ſucceſſively took their ſtations on Pindus, Parnaſſus, Helicon, and all thoſe ſolitary places where the painters of nature, ſurrounded by the moſt pleaſing images, experience the divine glow of inſpiration."

* *Travels of Anacharſis*, vol. iii. p. 261.

Pythagoras, and afterwards Plato, make the muſes the ſoul of the planets in our ſyſtem; from whence the imaginary muſic of the ſpheres.

Muſeum ‖ Muſhroom.

MUSEUM, a name which originally ſignified a part of the palace of Alexandria, which took up at leaſt one-fourth of the city. This quarter was called the *muſeum*, on account of its being ſet apart for the muſes and the ſtudy of the ſciences. Here were lodged and entertained the men of learning; who were divided into many companies or colleges, according to the ſciences of which they were the profeſſors; and to each of theſe houſes or colleges was allotted a handſome revenue. The foundation of this eſtabliſhment is attributed to Ptolemy Philadelphus, who here placed his library. Hence the word *muſeum* is now applied to any place ſet apart as a repoſitory for things that have an immediate relation to the arts.

The muſeum at Oxford, called the *Aſhmolean muſeum*, is a noble pile of building, erected at the expence of the univerſity, at the weſt end of the theatre, at which ſide it has a magnificent portal, ſuſtained by pillars of the Corinthian order. The front, which is to the ſtreet, extends about 60 feet, where there is this inſcription over the entrance in gilt characters, *Muſeum Aſhmoleanum, ſchola naturalis hiſtoriæ, officina chymicha*. It was begun in 1679, and finiſhed in 1683, when a valuable collection of curioſities was preſented to the univerſity by Elias Aſhmole, Eſq; which were the ſame day repoſited there: ſeveral acceſſions have been ſince made to the muſeum; among which are hieroglyphics, and other Egyptian antiquities, an entire mummy, Roman antiquities, altars, medals, lamps, &c. and a variety of natural curioſities.

The Britiſh muſeum in London is a large, beautiful, and magnificent building, the nobleſt cabinet of curioſities in the world. See the article LONDON, n° 155.

MUSGRAVE (Dr William), a learned phyſician and antiquary, was born at Charlton-Muſgrave in Somerſetſhire, about the year 1657; and ſtudied at New-college, Oxford. Having diſtinguiſhed himſelf by his knowledge in his profeſſion, and his ſkill in natural philoſophy, he was elected fellow of the Royal Society; and being made ſecretary in 1684, he continued the Philoſophical Tranſactions from n° 167 to n° 178 incluſive. After having taken his degrees in phyſic, and being admitted a fellow of the college of phyſicians, he went and ſettled at Exeter, where he practiſed phyſic with great reputation and ſucceſs. Being a man of extenſive learning, he compoſed, at his leiſure-hours, ſeveral curious and valuable works; as, 1. *De arthritide anomala ſive interna diſſertatio*. 2. *De arthritide ſymptomatica diſſertatio*. 3. *Julii Vitalis epitaphium, cum commentario*. 4. *De legionibus epiſtola*. 5. *De aquilis Romanis epiſtola*. 6. *Inſcriptio Terraconenſis, cum commentario*. 7. *Geta Britannicus*, &c.—8. *Belgium Britannicum*. This learned phyſician died in 1721.

MUSHROOM, in botany. See AGARICUS and LYNCURIUS.

To try the quality of muſhrooms:—Take an onion, and ſtripe the outer ſkin, and boil it with your muſhrooms: if the onion become blue or black, there are certainly dangerous ones amongſt them; if it remain white, they are good.

MUSIC;

M U S I C;

1 Definition. THE art of combining ſounds in a manner agreeable to the ear. This combination may be either ſimultaneous or ſucceſſive: in the firſt caſe, it conſtitutes harmony; in the laſt, melody. But though the ſame ſounds, or intervals of ſound, which give pleaſure when heard in ſucceſſion, will not always produce the ſame effect in harmony; yet the principles which conſtitute the ſimpler and more perfect kinds of harmony, are almoſt, if not entirely, the ſame with thoſe of melody. By *perfect harmony*, we do not here mean that plenitude, thoſe complex modifications of harmonic ſound, which are admired in practice; but that harmony which is called *perfect* by theoricians and artiſts; that harmony which reſults from the coaleſcence of ſimultaneous ſounds produced by vibrations in the proportions of thirds, fifths, and octaves, or their duplicates.

The principles upon which theſe various combinations of ſound are founded, and by which they are regulated, conſtitute a ſcience, which is not only extenſive but profound, when we would inveſtigate the principles from whence theſe happy modifications of ſound reſult, and by which they are determined; or when we would explore the ſenſations, whether mental or corporeal, with which they affect us. The ancient definitions of muſic are not proportioned in their extent to our preſent ideas of that art; but M. Rouſſeau betrays a temerity highly inconſiſtent with the philoſophical character, when from thence he infers, that their ideas were vague and undetermined. Every ſoul ſuſceptible of refinement and delicacy in taſte or ſentiment, muſt be conſcious that there is a muſic in action as well as in ſound; and that the ideas of beauty and decorum, of harmony and ſymmetry, are, if we may uſe the expreſſion, equally conſtituent of viſible as of audible muſic. Thoſe illuſtrious minds, whoſe comprehenſive proſpects in every ſcience where taſte and propriety prevail took in nature at a ſingle glance, would behold with contempt and ridicule thoſe narrow and microſcopic views of which alone their ſucceſſors in philoſophy have diſcovered themſelves capacious. With theſe definitions, however, we are leſs concerned, as they bear no proportion to the ideas which are now entertained of muſic. Nor can we follow M. Rouſſeau, from whatever venerable ſources his authority may be derived, in adopting his Egyptian etymology for the word *muſic*. The eſtabliſhed derivation from *Muſa* could only be queſtioned by a paradoxical genius. That muſic had been practiſed in Egypt before it was known as an art in Greece, is indeed a fact which cannot be queſtioned; but it does not thence follow that the Greeks had borrowed the name as well as the art from Egypt. If the art of muſic be ſo natural to man that vocal melody is practiſed wherever articulate ſounds are uſed, there can be little reaſon for deducing the idea of muſic from the whiſtling of winds through the reeds that grew on the river Nile. And indeed, when we reflect with how eaſy a tranſition we may paſs from the accents of ſpeaking to diatonic ſounds; when we obſerve how early children adapt the language of their amuſements to meaſure and melody, however rude; when we conſider how early and univerſally theſe practices take place—there is no avoiding the concluſion, that the idea of muſic is connatural to man, and implied in the original principles of his conſtitution. We have already ſaid, that the principles on which it is founded, and the rules by which it is conducted, conſtitute a ſcience. The ſame maxims when applied to practice form an art: hence its firſt and moſt capital diviſion is into *ſpeculative* and *practical* muſic.

Speculative muſic is, if we may be permitted to uſe the expreſſion, the knowledge of the nature and uſe of thoſe materials which compoſe it; or, in other words, of all the different relations between the high and low, between the harſh and the ſweet, between the ſwift and the ſlow, between the ſtrong and the weak, of which ſounds are ſuſceptible: relations which, comprehending all the poſſible combinations of muſic and ſounds, ſeem likewiſe to comprehend all the cauſes of the impreſſions which their ſucceſſion can make upon the ear and upon the ſoul.

Practical muſic is the art of applying and reducing to practice thoſe principles which reſult from the theory of agreeable ſounds, whether ſimultaneous or ſucceſſive; or, in other words, to conduct and arrange ſounds according to the proportions reſulting from conſonance, from duration and ſucceſſion, in ſuch a manner as to produce upon the ear the effect which the compoſer intends. This is the art which we call *compoſition* *. With reſpect to the actual production of ſounds by voices or inſtruments, which is called *execution*, this department is merely mechanical and operative: which, only preſuppoſing the powers of ſounding the intervals true, of exactly proportioning their degrees of duration, of elevating or depreſſing ſounds according to thoſe gradations which are preſcribed by the tone, and to the value required by the time, demands no other knowledge but a familiar acquaintance with the characters uſed in muſic, and a habit of expreſſing them with promptitude and facility.

* See Compoſition.

Speculative muſic is likewiſe divided into two departments; *viz.* the knowledge of the proportions of ſounds or their intervals, and that of their relative durations; that is to ſay, of meaſure and of time.

The firſt is what among the ancients ſeems to have been called *harmonical* muſic. It ſhows in what the nature of air or melody conſiſts; and diſcovers what is conſonant or diſcordant, agreeable or diſagreeable, in the modulation. It diſcovers, in a word, the effects which ſounds produce on the ear by their nature, by their force, and by their intervals; which is equally applicable to their conſonance and their ſucceſſion.

The ſecond has been called *rhythmical*, becauſe it treats of ſounds with regard to their time and quantity. It contains the explication of their continuance, of their proportions, of their meaſures whether long or

ſhort, quick or ſlow, of the different modes of time and the parts into which they are divided, that to theſe the ſucceſſion of ſounds may be conformed.

Practical muſic is likewiſe divided into two departments, which correſpond to the two preceding.

That which anſwers to *harmonical* muſic, and which the ancients called *melopée*, teaches the rules for combining and varying the intervals, whether conſonant or diſſonant, in an agreeable and harmonious manner.

The ſecond, which anſwers to the *rhythmical* muſic, and which they called *rhythmopée*, contains the rules for applying the different modes of time, for underſtanding the feet by which verſes were ſcanned, and the diverſities of meaſure; in a word, for the practice of the rhythmus.

Muſic is at preſent divided more ſimply into *melody* and *harmony;* for ſince the introduction of *harmony* the proportion between the length and ſhortneſs of ſounds, or even that between the diſtance of returning cadences, are of leſs conſequence amongſt us. For it often happens in modern languages, that the verſes aſſume their meaſures from the muſical air, and almoſt entirely loſe the ſmall ſhare of proportion and quantity which in themſelves they poſſeſs.

By melody the ſucceſſions of ſound are regulated in ſuch a manner as to produce pleaſing airs. See MELODY.

Harmony conſiſts in uniting to each of the ſounds, in a regular ſucceſſion, two or more different ſounds, which ſimultaneouſly ſtriking the ear ſoothe it by their concurrence. See HARMONY.

Muſic, according to Rouſſeau, may be, and perhaps likewiſe ought to be, divided into the *phyſical* and the *imitative*. The firſt is limited to the mere mechaniſm of ſounds, and reaches no farther than the external ſenſes, without carrying its impreſſions to the heart, and can produce nothing but corporeal ſenſations more or leſs agreeable. Such is the muſic of ſongs, of hymns, of all the airs which only conſiſt in combinations of melodious ſounds, and in general all muſic which is merely harmonious.

It may, however, be queſtioned, whether every ſound, even to the moſt ſimple, is not either by nature or by early and confirmed aſſociation, *imitative*. If we may truſt our own feelings, there is no ſuch thing in nature as muſic which gives mechanical pleaſure alone. For if ſo, it muſt give ſuch pleaſure as we receive from taſtes, from odours, or from other grateful titillations; but we abſolutely deny that there are any muſical ſenſations or pleaſures in the ſmalleſt degree analogous to theſe. Let any piece of muſic be reſolved into its elementary parts and their proportions, it will then eaſily appear from this analyſis, that ſenſe is no more than the vehicle of ſuch perceptions, and that mind alone can be ſuſceptible of them. It may indeed happen, from the number of the performers and the complication of the harmony, that meaning and ſentiment may be loſt in the multiplicity of ſounds; but this, though it may be harmony, loſes the name of *muſic*.

The ſecond department of this diviſion, by lively and accentuated inflections, and by ſounds which may be ſaid to ſpeak, expreſſes all the paſſions, paints every poſſible picture, reflects every object, ſubjects the whole of nature to its ſkilful imitations, and impreſſes even on the heart and ſoul of man ſentiments proper to affect them in the moſt ſenſible manner. This, continues he, which is the genuine lyric and theatrical muſic, was what gave double charms and energy to ancient poetry; this is what, in our days, we exert ourſelves in applying to the drama, and what our fingers execute on the ſtage. It is in this muſic alone, and not in harmonics or the reſonance of nature, that we muſt expect to find accounts of thoſe prodigious effects which it formerly produced.

But, with M. Rouſſeau's permiſſion, all muſic which is not in ſome degree characteriſed by theſe pathetic and imitative powers, deſerves no better name than that of a *muſical jargon*, and can only be effectuated by ſuch a complication and intricacy of harmony, as may confound, but cannot entertain the audience. This character, therefore, ought to be added as eſſential to the definition of muſic; and it muſt be attributed to our neglect of this alone, whilſt our whole attention is beſtowed on harmony and execution, that the beſt performances of our artiſts and compoſers are heard with liſtleſs indifference and oſcitation, nor ever can conciliate any admirers, but ſuch as are induced, by pedantry and affectation, to pretend what they do not feel. Still may the curſe of indifference and inattention purſue and harrow up the ſouls of every compoſer or performer, who pretends to regale our ears with this muſical legerdemain, till the grin of ſcorn, or the hiſs of infamy, teach them to correct this depravity of taſte, and entertain us with the voice of nature!

Whilſt moral effects are ſought in the natural effects of ſound alone, the ſcrutiny will be vain, and diſputes will be maintained without being underſtood: but ſounds, as repreſentatives of objects, whether by nature or aſſociation, introduce new ſcenes to the fancy and new feelings to the heart; not from their mechanical powers, but from the connection eſtabliſhed by the Author of our frame between ſounds and the objects which either by natural reſemblance or unavoidable aſſociation they are made to repreſent.

It would ſeem that muſic was one of thoſe arts which were firſt diſcovered: and that vocal was prior to inſtrumental muſic, if in the earlieſt ages there was any muſic which could be ſaid to be purely inſtrumental. For it is more than probable, that muſic was originally formed to be the vehicle of poetry; and of conſequence, though the voice might be ſupported and accompanied by inſtruments, yet muſic was never intended for inſtruments alone.

We are told by ancient authors, that all the laws, whether human or divine, exhortations to virtue, the knowledge of the characters and actions of gods and heroes, the lives and atchievements of illuſtrious men, were written in verſe, and ſung publicly by a quire to the ſound of inſtruments; and it appears from the Scriptures, that ſuch from the earlieſt times was the cuſtom among the Iſraelites. Nor was it poſſible to find means more efficacious for impreſſing on the mind of man the principles of morals, and inſpiring the love of virtue. Perhaps, however, this was not the reſult of a premeditated plan; but inſpired by ſublime ſentiments and elevation of thought, which in accents that were ſuited and proportioned to their celeſtial nature endeavoured to find a language worthy of themſelves and expreſſive of their grandeur.

It merits attention, that the ancients were duly ſenſible

ſible of the value and importance of this divine art, not only as a ſymbol of that univerſal order and ſymmetry which prevails through the whole frame of material and intelligent nature, but as productive of the moſt momentous effects both in moral and political life. Plato and Ariſtotle, who diſagreed almoſt in every other maxim of politics, are unanimous in their approbation of muſic, as an efficacious inſtrument in the formation of the public character and in conducting the ſtate; and it was the general opinion, that whilſt the gymnaſtic exerciſes rendered the conſtitution robuſt and hardy, muſic humaniſed the character, and ſoftened thoſe habits of roughneſs and ferocity by which men might otherwiſe have degenerated into ſavages. The gradations by which voices were exerted and tuned, by which the invention of one inſtrument ſucceeded to another, or by which the principles of muſic were collected and methodiſed in ſuch a manner as to give it the form of an art and the dignity of a ſcience, are topics ſo fruitful of conjecture and ſo void of certainty, that we muſt leave them to employ minds more ſpeculative and inventions more prolific than ours, or transfer them to the *Hiſtory* of Muſic as a more proper place for ſuch diſquiſitions. For the amuſement of the curious, Rouſſeau in his *Muſical Dictionary*, Plates C and N, has tranſcribed ſome fragments of Grecian, Perſian, American, Chineſe, and Swiſs muſic, with which performers may entertain themſelves at leiſure. When they have tried the pieces, it is imagined they will be leſs ſanguinely fond than that author of aſcribing the power of muſic to its affinity with the national accents where it is compoſed. This may doubtleſs have its influence; but there are other cauſes more permanent and leſs arbitrary to which it owes its moſt powerful and univerſal charms.

The muſic now moſt generally celebrated and practiſed is that of the Italians, or their ſucceſsful imitators. The Engliſh, from the invaſion of the Saxons, to that more late though lucid era in which they imbibed the art and copied the manner of the Italians, had a muſic which neither pleaſed the ſoul nor charmed the ear. The primitive muſic of the French deſerves no higher panegyric. Of all the barbarous nations, the Scots and Iriſh ſeem to have poſſeſſed the moſt affecting original muſic. The firſt conſiſts of a melody characteriſed by tenderneſs: It melts the ſoul to a pleaſing penſive languor. The other is the native expreſſion of grief and melancholy. Taſſoni informs us, that in his time a prince from Scotland had imported into Italy a lamentable kind of muſic from his own country; and that he himſelf had compoſed pieces in the ſame ſpirit. From this expreſſive though laconic deſcription, we learn, that the character of our national muſic was even then eſtabliſhed; yet ſo groſs is our ignorance and credulity, that we aſcribe the beſt and moſt impaſſioned airs which are extant among us to David Rizzio; as if an Italian Lutaniſt, who had lived ſo ſhort a time in Scotland, could at once, as it were by inſpiration, have imbibed a ſpirit and compoſed in a manner ſo different from his own. It is yet more ſurpriſing that Geminiani ſhould have entertained and publiſhed the ſame prejudice, upon the miſerable authority of popular tradition alone; for the fact is authenticated by no better credentials. The primitive muſic of the Scots may be divided into the *martial*, the *paſtoral*, and the *feſtive*. The *firſt* conſiſts either in marches, which were played before the chieftains, in imitation of the battles which they fought, or in lamentations for the cataſtrophes of war and the extinction of families. Theſe wild effuſions of natural melody preſerve ſeveral of the rules preſcribed for compoſition. The ſtrains, though rude and untutored, are frequently terrible or mournful in a very high degree. The port or march is ſometimes in common, ſometimes in treble time; regular in its meaſures, and exact in the diſtance between its returning cadences; moſt frequently, though not always, loud and briſk. The *pibroch*, or imitation of battles, is wild, and abrupt in its tranſitions from interval to interval and from key to key; various and deſultory in its movements; frequently irregular in the return of its cadences; and in ſhort, through the whole, ſeems inſpired with ſuch fury and enthuſiaſm, that the hearer is irreſiſtibly infected with all the rage of precipitate courage, notwithſtanding the rudeneſs of the accents by which it is kindled. To this the *paſtoral* forms a ſtriking contraſt. Its accents are plaintive, yet ſoothing; its harmony generally flat; its modulations natural and agreeable; its rhythmus ſimple and regular; its returning cadences at equal diſtance; its tranſitions from one concinnous interval to another, at leaſt for the moſt part; its movements ſlow, and may be either in common or treble time. It ſcarcely admits of any other harmony than that of a ſimple baſs. A greater number of parts would cover the air and deſtroy the melody. To this we ſhall add what has been ſaid upon the ſame ſubject by Dr Franklin. Writing to Lord K——, he proceeds thus:

"Give me leave, on this occaſion, to extend a little the ſenſe of your poſition, 'That melody and harmony are ſeparately agreeable, and in union delightful;' and to give it as my opinion, that the reaſon why the Scotch tunes have lived ſo long, and will probably live for ever (if they eſcape being ſtifled in modern affected ornament), is merely this, that they are really compoſitions of melody and harmony united, or rather that their melody is harmony. I mean, the ſimple tunes ſung by a ſingle voice. As this will appear paradoxical, I muſt explain my meaning. In common acceptation, indeed, only an agreeable *ſucceſſion* of ſounds is called *melody*; and only the *coexiſtence* of agreeable ſounds, *harmony*. But ſince the memory is capable of retaining for ſome moments a perfect idea of the pitch of a paſt ſound, ſo as to compare it with the pitch of a ſucceeding ſound, and judge truly of their agreement or diſagreement, there may and does ariſe from thence a ſenſe of harmony between the preſent and paſt ſounds, equally pleaſing with that between two preſent ſounds. Now the conſtruction of the old Scotch tunes is this, that almoſt every ſucceeding emphatical note is a third, a fifth, an octave, or in ſhort ſome note that is in concord with the preceding note. Thirds are chiefly uſed, which are very pleaſing concords. I uſe the word *emphatical*, to diſtinguiſh thoſe notes which have a ſtreſs laid on them in ſinging the tune, from the lighter connecting notes that ſerve merely, like grammar-articles in common ſpeech, to tack the whole together.

"That we have a moſt perfect idea of a ſound juſt paſt, I might appeal to all acquainted with muſic,

who know how eaſy it is to repeat a ſound in the ſame pitch with one juſt heard. In tuning an inſtrument, a good ear can as eaſily determine that two ſtrings are in uniſon by ſounding them ſeparately, as by ſounding them together; their diſagreement is alſo as eaſily, I believe I may ſay more eaſily and better diſtinguiſhed when ſounded ſeparately; for when ſounded together, though you know by the beating that one is higher than the other, you cannot tell which it is. I have aſcribed to memory the ability of comparing the pitch of a preſent tone with that of one paſt. But if there ſhould be, as poſſibly there may be, ſomething in the ear ſimilar to what we find in the eye, that ability would not be entirely owing to memory. Poſſibly the vibrations given to the auditory nerves by a particular ſound may actually continue for ſome time after the cauſe of theſe vibrations is paſt, and the agreement or diſagreement of a ſubſequent ſound become by compariſon with them more diſcernible. For the impreſſion made on the viſual nerves by a luminous object will continue for 20 or 30 ſeconds."

After ſome experiments to prove the permanency of viſible impreſſions, he continues thus:

"Farther, when we conſider by whom theſe ancient tunes were compoſed, and how they were firſt performed, we ſhall ſee that ſuch harmonical ſucceſſions of ſounds was natural and even neceſſary in their conſtruction. They were compoſed by the minſtrels of thoſe days, to be played on the harp accompanied by the voice. The harp was ſtrung with wire, which gives a ſound of long continuance; and had no contrivance like that of the modern harpſichord, by which the ſound of the preceding note can be ſtopt the moment a ſucceeding note begins. To avoid actual diſcord, it was therefore neceſſary that the ſucceeding emphatic note ſhould be a cord with the preceding, as their ſounds muſt exiſt at the ſame time. Hence aroſe that beauty in thoſe tunes that has ſo long pleaſed, and will pleaſe for ever, though men ſcarce know why. That they were originally compoſed for the harp, and of the moſt ſimple kind, I mean a harp without any half-notes but thoſe in the natural ſcale, and with no more than two octaves of ſtrings, from C to C, I conjecture from another circumſtance; which is, that not one of theſe tunes, really ancient, has a ſingle artificial half-note in it; and that in tunes where it is moſt convenient for the voice to uſe the middle notes of the harp, and place the key in F, there the B, which if uſed ſhould be a B flat, is always omitted, by paſſing over it with a third. The connoiſſeurs in modern muſic will ſay I have no taſte: but I cannot help adding, that I believe our anceſtors, in having a good ſong, diſtinctly articulated, ſung to one of thoſe tunes, and accompanied by the harp, felt more real pleaſure than is communicated by the generality of modern operas, excluſive of that ariſing from the ſcenery and dancing. Moſt tunes of late compoſition, not having this natural harmony united with their melody, have recourſe to the artificial harmony of a baſs, and other accompanying parts. This ſupport, in my opinion, the old tunes do not need, and are rather confuſed than aided by it. Whoever has heard *James Oſwald* play them on his violincello, will be leſs inclined to diſpute this with me. I have more than once ſeen tears of pleaſure in the eyes of his auditors: and yet I think, even *his* playing thoſe tunes would pleaſe more if he gave them leſs modern ornament."

As theſe obſervations are for the moſt part true and always ingenious, we need no other apology for quoting them at length. It is only proper to remark, that the tranſition in Scots muſic by conſonant intervals, does not ſeem, as Dr Franklin imagines, to ariſe from the nature of the inſtruments upon which they played. It is more than probable, that the ancient Britiſh harp was not ſtrung with wire, but with the ſame materials as the Welſh harps at preſent. Theſe ſtrings have not the ſame permanency of tone as metal; ſo that the ſound of a preceding emphatic note muſt have expired before the ſubſequent accented note could be introduced. Beſides, they who are acquainted with the manœuvre of the Iriſh harp, know well that there is a method of diſcontinuing ſounds no leſs eaſy and effectual than upon the harpſichord. When the performer finds it proper to interrupt a note, he has no more to do but return his finger gently upon the ſtring immediately ſtruck, which effectually ſtops its vibration.

That ſpecies of Scots muſic which we have diſtinguiſhed by the name of *feſtive* ſeems now limited to reels and country-dances. Theſe may be either in common or treble time. They moſt frequently conſiſt of two ſtrains: each of theſe contains eight or twelve bars. They are truly rhythmical; but the mirth which they excite ſeems rather to be inſpired by the vivacity of the movement, than either by the force or variety of the melody. They have a manœuvre and expreſſion peculiar to themſelves, which it is impoſſible to deſcribe, and which can only be exhibited by good performers.

THUS far we have purſued the general idea of muſic. We ſhall, after the hiſtory, give a more particular detail of the ſcience from Monſieur D'Alembert.

HISTORY OF MUSIC.

No accurate accounts of the ſtate of muſic in the earlieſt ages of the world.

MUSIC is capable of a variety ſo infinite, ſo greatly does the moſt ſimple differ from the moſt complex, and ſo multiplied are the degrees between theſe two extremes, that in no age could the incidents reſpecting that faſcinating art have been few or unintereſting. But, that accounts of theſe incidents ſhould have been handed down to us, ſcanty and imperfect, is no matter of ſurpriſe, when we recollect that the hiſtory of muſic is the hiſtory only of ſounds, of which writing is a very inadequate medium; and that men would long employ themſelves in the pleaſing exerciſe of cultivating muſic before they poſſeſſed either the ability or the inclination to record their exertions.

No accurate traces, therefore, of the actual ſtate of muſic, in the earlier ages of the world, can be diſcerned. Our ideas on the ſubject have no foundation firmer than conjecture and analogy.

It is probable, that among all barbarous nations ſome degree of ſimilarity is diſcernible in the ſtyle of their

their mufic. Neither will much difference appear during the firſt dawnings of civilization. But in the more advanced periods of ſociety, when the powers of the human mind are permitted without obſtacle to exert their native activity and tendency to invention, and are at the ſame time affected by the infinite variety of circumſtances and ſituations which before had no exiſtence, and which in one caſe accelerate, and in another retard; then that ſimilarity, once ſo diſtinguiſhable, gives place to the endleſs diverſity of which the ſubject is capable.

3 Mufic not the invention of any one man.

The practice of mufic being univerſal in all ages and all nations, it would be abſurd to attribute the invention of the art to any one man. It muſt have ſuffered a regular progreſſion, through infancy, childhood, and youth, before it could arrive at maturity. The firſt attempts muſt have been rude and artleſs; perhaps the firſt flute was a reed of the lake.

No nation has been able to produce proofs of antiquity ſo indiſputable as the Egyptians; it would be vain, therefore, to attempt tracing mufic higher than the hiſtory of Egypt.

4 Egyptian mufic.

By comparing the accounts of Diodorus Siculus and of Plato, there is reaſon to ſuppoſe, that in very ancient times the ſtudy of mufic in Egypt was confined to the prieſthood, who uſed it only on religious and ſolemn occaſions; that, as well as ſculpture, it was circumſcribed by law; that it was eſteemed ſacred, and forbidden to be employed on light or common occaſions; and that innovation in it was prohibited: but what the ſtyle or relative excellence of this very ancient mufic was, there are no traces by which we can form an accurate judgment. After the reigns of the Pharaohs, the Egyptians fell by turns under the dominion of the Ethiopians, the Perſians, the Greeks, and the Romans. By ſuch revolutions, the manners and amuſements of the people, as well as their form of government, muſt have been changed. In the age of the Ptolemies, the muſical games and conteſts inſtituted by thoſe monarchs were of Greek origin, and the muſicians who performed were chiefly Greek.

The moſt ancient monuments of human art and induſtry, at preſent extant at Rome, are the obeliſks brought thither from Egypt, two of which are ſaid to have been erected by Seſoſtris at Heliopolis, about 400 years before the ſiege of Troy. Theſe were by the order of Auguſtus brought to Rome after the conqueſt of Egypt. One of them called *guglia rotta*, or the broken pillar, which during the ſacking of the city in 1527 was thrown down and broken, ſtill lies in the Campus Martius. On it is ſeen the figure of a muſical inſtrument of two ſtrings, and with a neck. It reſembles much the calaſcione ſtill uſed in the kingdom of Naples.

5 An Egyptian muſical inſtrument.

This curious relict of antiquity is mentioned, becauſe it affords better evidence than, on the ſubject of ancient mufic, is uſually to be met with, that the Egyptians, at ſo very early a period of their hiſtory, had advanced to a conſiderable degree of excellence in the cultivation of the arts. By means of its neck, this inſtrument was capable, with only two ſtrings, of producing a great number of notes. Theſe two ſtrings, if tuned fourths to each other, would furniſh that ſeries of ſounds called by the ancients *heptachord*, which conſiſts of a conjunct tetrachord as B, C, D, E; E, F, G, A; if tuned fifths, they would produce an octave, or two disjunct tetrachords. The calaſcione is tuned in this laſt manner. The annals of no nation other than Egypt, for many ages after the period of the obeliſk at Heliopolis, exhibit the veſtige of any contrivance to ſhorten ſtrings during performance by a neck or finger-board. Father Montfaucon obſerves, that after examining 500 ancient lyres, harps, and citharas, he could diſcover no ſuch thing.

Egypt indeed ſeems to have been the ſource of human intelligence, and the favourite reſidence of genius and invention. From that celebrated country did the Greeks derive their knowledge of the firſt elements of thoſe arts and ſciences in which they afterwards ſo eminently excelled. From Greece again did the Romans borrow their attainments in the ſame purſuits. And from the records of thoſe different nations have the moderns been enabled to accompliſh an improvement ſo wonderful in literature.

6 The Egyptian Hermes the inventor of the lyre.

The Hermes or Mercury of the Egyptians, ſirnamed *Triſmegiſtus*, or *thrice illuſtrious*, who was, according to Sir Iſaac Newton, the ſecretary of Oſiris, is celebrated as the inventor of mufic. It has already been obſerved, that no one perſon ought ſtrictly to be called the inventor of an art which ſeems to be natural to, and coeval with, the human ſpecies; but the Egyptian Mercury is without doubt intitled to the praiſe of having made ſtriking improvements in mufic, as well as of having advanced in various reſpects the civilization of the people, whoſe government was chiefly committed to his charge. The account given by Apollodorus of the manner in which he accidentally invented the lyre, is at once entertaining and probable. "The Nile (ſays Apollodorus), after having overflowed the whole country of Egypt, when it returned within its natural bounds, left on the ſhore a great number of dead animals of various kinds, and among the reſt a tortoiſe; the fleſh of which being dried and waſted by the ſun, nothing remained within the ſhell but nerves and cartilages, and theſe being braced and contracted by the drying heat became ſonorous. Mercury, walking along the banks of the Nile, happened to ſtrike his foot againſt this ſhell; and was ſo pleaſed with the ſound produced, that the idea of a lyre ſtarted into his imagination. He conſtructed the inſtrument in the form of a tortoiſe, and ſtrung it with the dried ſinews of dead animals."

How beautiful to conceive the energetic powers of the human mind in the early ages of the world, exploring the yet undiſcovered capabilities of nature, and directed to the inexhauſtible ſtore by the finger of God, in the form of accident!

7 The ſingle flute of the Egyptians.

The monaulos, or ſingle flute, called by the Egyptians photinx, was probably one of the moſt ancient inſtruments uſed either by them or any other nation. From various remains of ancient ſculpture, it appears to have been ſhaped like a bull's horn, and was at firſt, it may be ſuppoſed, no other than the horn itſelf.—Before the invention of flutes, as no other inſtrument except thoſe of percuſſion were known, mufic muſt have been little more than metrical. When the art of refining and lengthening ſounds was firſt diſcovered,

the power of muſic over mankind, from the agreeable ſurpriſe occaſioned by ſoft and extended notes, was probably irreſiſtible. At a time when all the reſt of the world was involved in ſavage ignorance, the Egyptians were poſſeſſed of muſical inſtruments capable of much variety and expreſſion —Of this the aſtoniſhing remains of the city Thebes ſtill ſubſiſting afford ample evidence. In a letter from Mr Bruce, ingroſſed in Dr Burney's Hiſtory of Muſic, there is given a particular deſcription of the Theban harp, an inſtrument of extenſive compaſs, and exquiſite elegance of form. It is accompanied with a drawing taken from the ruins of an ancient ſepulchre at Thebes, ſuppoſed by Mr Bruce to be that of the father of Seſoſtris.

8 The Theban harp of Egypt.

On the ſubject of this harp, Mr Bruce makes the following ſtriking obſervation. "It overturns all the accounts of the earlieſt ſtate of ancient muſic and inſtruments in Egypt, and is altogether, in its form, ornaments, and compaſs, an inconteſtable proof, ſtronger than a thouſand Greek quotations, that geometry, drawing, mechanics, and muſic, were at the greateſt perfection when this harp was made; and that what we think in Egypt was the invention of arts was only the beginning of the æra of their reſtoration."

Indeed, when the beauty and powers of this harp, along with the very great antiquity of the painting which repreſents it, are conſidered, ſuch an opinion as that which Mr Bruce hints at, does not ſeem to be devoid of probability.

It cannot be doubted that during the reigns of the Ptolemies, who were voluptuous princes, muſic muſt have been much cultivated and encouraged. The father of Cleopatra, who was the laſt of that race of kings, derived his title of auletes, or flute-player, from his exceſſive attachment to the flute. Like Nero, he uſed to array himſelf in the dreſs of a tibicen, and exhibit his performance in the public muſical conteſts.

Some authors, particularly Am. Marcellinus and M. Pau, refuſe to the Egyptians, at any period of their hiſtory, any muſical genius, or any excellence in the art; but the arguments uſed to ſupport this opinion ſeem to be inconcluſive, and the evidences of the oppoſite deciſion appear to be inconteſtable.

9 Hebrew muſic

The ſacred Scriptures afford almoſt the only materials from which any knowledge of Hebrew muſic can be drawn. In the rapid ſketch, therefore, of ancient muſic which we mean to exhibit, a very few obſervations are all which can properly be given to that department of our ſubject.

Moſes, who led the Iſraelites out of Egypt, was educated by Pharaoh's daughter in all the literature and elegant arts cultivated in that country. It is probable, therefore, that the taſte and ſtyle of Egyptian muſic would be infuſed in ſome degree into that of the Hebrews. Muſic appears to have been interwoven through the whole tiſſue of religious ceremony in Paleſtine. The prieſthood ſeem to have been muſicians hereditarily and by office. The prophets appear to have accompanied their inſpired effuſions with muſic; and every prophet, like the preſent improviſatori of Italy, ſeems to have been accompanied by a muſical inſtrument.

Muſic, vocal and inſtrumental, conſtituted a great part of the funeral ceremonies of the Jews. The pomp and expence uſed on theſe occaſions advanced by degrees to an exceſſive extent. The number of flute-players in the proceſſions amounted ſometimes to ſeveral hundreds, and the attendance of the gueſts continued frequently for 30 days †.

† *Joſephus.* L. 3. c. 9.

The Hebrew language abounds with conſonants, and has ſo few vowels, that in the original alphabet they had no characters. It muſt, therefore, have been harſh and unfavourable to muſic. Their inſtruments of muſic were chiefly thoſe of percuſſion; ſo that, both on account of the language and the inſtruments, the muſic muſt have been coarſe and noiſy. The vaſt numbers of performers too, whom it was the taſte of the Hebrews to collect together, could with ſuch language and ſuch inſtruments produce nothing but clamour and jargon. According to Joſephus, there were 200,000 muſicians at the dedication of Solomon's temple. Such are the circumſtances from which only an idea of Hebrew muſic can be formed; for the Jews neither ancient nor modern have ever had any characters peculiar to muſic; and the melodies uſed in their religious ceremonies have at all times been entirely traditional.

10 coarſe and noiſy.

11 Grecian muſic.

Cadmus, wiſh the Phœnician colony which he led into Greece, imported at the ſame time various arts into that country. By the aſſiſtance of his Phœnician artificers, that chief diſcovered gold in Thrace and copper at Thebes. At Thebes that metal is ſtill termed *cadmia*. Of theſe materials, and of iron, they formed to themſelves armour and inſtruments of war. Theſe they ſtruck againſt each other during their dances at ſacrifices, by which they firſt obtained the idea of muſic. Such is the account given of the origin of that ſpecies of muſic in Greece produced by inſtruments of percuſſion. The invention of wind inſtruments in Greece is attributed to Minerva; and to the Grecian Mercury is aſſigned, by the poets and hiſtorians of that country, the honour of many diſcoveries probably due to the Egyptian Hermes, particularly the invention of ſtringed inſtruments. The lyre of the Egyptian Mercury had only three ſtrings; that of the Grecian ſeven: the laſt was perhaps no more than an improvement on the other. When the Greeks deified a prince or hero of their own country, they uſually aſſigned him an Egyptian name, and with the name beſtowed on their new divinity all the actions, attributes, and rites of the original.

The Grecian lyre, although ſaid to have been invented by Mercury, was cultivated principally by Apollo, who firſt played upon it with method, and accompanied it with the voice. The celebrated conteſt between him and Marſyas is mentioned by various authors; in which, by conjoining the voice with his lyre (a combination never before attempted), his muſic was declared ſuperior to the flute of Marſyas. The progreſs of the lyre, according to Diodorus Siculus, is the following. "The muſes added to the Grecian lyre the ſtring called *meſe*; Linus that of lichanos; and Orpheus and Thamyras thoſe ſtrings which are named hypate and parhypate." It has been already mentioned, that the lyre invented by the Egyptian Mercury had but three ſtrings; by putting theſe circumſtances together, we may perhaps acquire ſome knowledge of the progreſs of muſic, or at leaſt of the extenſion of its ſcale in the higheſt antiquity. *Meſe*, in the Greek muſic, is the fourth ſound of the ſecond tetrachord

12 Progreſs of the Grecian lyre.

tetrachord of the great ſyſtem and firſt tetrachord invented by the ancients, anſwering to our A, on the fifth line in the baſe. If this ſound then was added to the former three, it proves that the moſt ancient tetrachord was that from E in the baſe to A; and that the three original ſtrings in the Mercurian and Apollonian lyre were tuned E, F, G, which the Greeks call *hypate meſon*, *parhypate meſon*, and *meſon diatonos*; the addition, therefore, of *meſe* to theſe completed the firſt and moſt ancient tetrachord E, F, G, A. The ſtring lichanos again being added to theſe, and anſwering to our D on the third line in the baſe, extended the compaſs downwards, and gave the ancient lyre a regular ſeries of five ſounds. The two ſtrings hypate and parhypate, correſponding with our B and C in the baſe, completed the heptachord or ſeven ſounds b, c, d, e, f, g, a; a compaſs which received no addition till after the days of Pindar.

It might perhaps be expected, that in a hiſtory of Greek muſic ſomething ought to be ſaid concerning the muſes Apollo, Bacchus, and the other gods and demi-gods, who in the mythology of that country appear to have promoted and improved the art. But ſuch a diſcuſſion would be too diffuſive, and involve too much foreign matter for the plan we have choſen to adopt. We cannot avoid, however, making a few obſervations on the poems of Homer, in ſo far as connected with our ſubject. It has been imagined, with much appearance of probability, that the occupation of the firſt poets and muſicians of Greece reſembled that of the Celtic and German bards and the ſcalds of Iceland and Scandinavia. They ſung their poems in the ſtreets of cities and in the palaces of princes. They were treated with high reſpect, and regarded as inſpired perſons. Such was the employment of Homer. His poems, ſo juſtly celebrated, exhibit the moſt authentic picture that can be found in the annals of antiquity, although perhaps ſomewhat highly coloured, of the times of which he wrote and in which he lived. Muſic is always named throughout the Iliad and Odyſſey with rapture; but as in theſe poems no mention is made of inſtrumental muſic unaccompanied with poetry and ſinging, a conſiderable ſhare no doubt of the poet's praiſes is to be attributed to the poetry. The inſtruments moſt frequently named are the lyre, the flute, and the ſyrinx. The trumpet appears not to have been known at the ſiege of Troy, although it had come to be in uſe in the days of Homer himſelf. From the time of Homer till that of Sappho, there is almoſt a total blank in literature. Only a few fragments remain of the works of thoſe poets and muſicians whoſe names are preſerved as having flouriſhed between thoſe periods (†). During the century which elapſed between the days of Sappho and thoſe of Anacreon, no literary productions are preſerved entire.—From Anacreon to Pindar there is another chaſm of near a century. Subſequent to this time, the works ſtill extant of the three great tragic poets, Æſchylus, Sophocles, and Euripides, together with thoſe of Plato, Ariſtotle, Ariſtoxenus, Euclid, Theocritus, Callimachus, Polybius, and many others, produced all within a ſpace leſs than 300 years, diſtinguiſh this illuſtrious and uncommon period as that in which the whole powers of genius ſeem to have been exerted to illuminate and inſtruct mankind in future ages. Then it was that eloquence, poetry, *muſic*, architecture, hiſtory, painting, ſculpture, like the ſpontaneous bloſſoms of nature, flouriſhed without the appearance of labour or of art.

The poets, as well epic as lyric and elegiac, were all likewiſe muſicians; ſo ſtrictly connected were muſic and poetry for many ages. It would afford amuſement to collect the biographical anecdotes of theſe favourites of genius, and to aſſign to each the reſpective improvements made by him in muſic and poetry; but our limits do not admit of ſo extenſive a diſquiſition; for which, therefore, reference muſt be made to the editors and commentators of theſe authors, and to the voluminous hiſtories of muſic lately publiſhed.

14 The invention of muſical characters.

The invention of notation and muſical characters marked a diſtinguiſhed æra in the progreſs of muſic. There are a diverſity of accounts reſpecting the perſon to whom the honour of that invention is due; but the evidences ſeem to preponderate in favour of Terpander, a celebrated poet and muſician, to whoſe genius muſic is much indebted. He flouriſhed about the 27th Olympiad, or 671 years before Chriſt.

Before that valuable diſcovery, muſic being entirely traditional, muſt have depended much on the memory and taſte of the performer.

There is an incident mentioned in the accounts handed down to us of the Olympic games, which may ſerve in ſome degree to mark the character of muſic at the time in which it happened. Lucian relates that a young flute-player named Harmonides, at his firſt public appearance in theſe games, began a ſolo with ſo violent a blaſt, on purpoſe to *ſurpriſe* and *elevate* the audience, that he *breathed his laſt breath into his flute*, and died on the ſpot. When to this anecdote, wonderful to us, and almoſt incredible, is added the circumſtance, that the trumpet-players at theſe public exhibitions expreſſed an exceſs of joy when they found their exertions had neither rent their cheeks nor burſt their blood-veſſels, ſome idea may be formed of the noiſy and vociferous ſtyle of muſic which then pleaſed; and from ſuch facts only can any opinion be obtained of the actual ſtate of ancient muſic.

15 Vociferous muſic of the Greeks.

In whatever *manner* the flute was played on, there is no doubt that it was long in Greece an inſtrument of high favour, and that the flute-players were held in much eſtimation. The flute uſed by Iſmenias, a celebrated Theban muſician, coſt at Corinth three talents, or L. 581, 5 s. If, ſays Xenophon, a bad flute-player would paſs for a good one, he muſt, like the *great flute-players*, expend large ſums on *rich furniture*, and appear in public *with a great retinue of ſervants*.

16 Extravagance of the ancients with reſpect to muſic.

The ancients, it appears, were not leſs extravagant in gratifying the miniſters of their pleaſures than ourſelves

13 Occupation of the firſt poets and muſicians in Greece.

(†) Heſiod lived ſo near to Homer, that it has been diſputed which of them is the moſt ancient. It is now, we believe, univerſally admitted, that the palm of antiquity is due to Homer; but we conſider them as having both flouriſhed in the ſame æra.

ſelves. Amœbæus, a harper, was paid an Attic talent, or L. 193, 15s. *per* day for his performance (‡).

It is proper to add, that the celebrated muſicians of Greece who performed in public were of *both* ſexes; and that the beautiful Lamia, who was taken captive by Demetrius, in the ſea engagement in which he vanquiſhed Ptolemy Soter, and who herſelf captivated her conqueror, as well as many other elevated female ſpirits, are recorded by ancient authors in terms of admiration, and of whom, did our limits here admit of biography, we would treat with pleaſure. The philoſophers of Greece, whoſe capacious minds graſped every other object of human intelligence, were not inattentive to the theory of muſic, or the philoſophy of ſound. This department of ſcience became the ſource of various ſects, and of much diverſity of opinion.—The founders of the moſt diſtinguiſhed ſects were Pythagoras and Ariſtoxenus. Of their theories, mention is made in the Appendix to this article.

17 Roman muſic.

Like every other people, the Romans, from their firſt origin as a nation, were poſſeſſed of a ſpecies of muſic which might be diſtinguiſhed as their own. It appears to have been rude and coarſe, and probably was a variation of the muſic in uſe among the Etruſcans and other tribes around them in Italy: but as ſoon as they began to open a communication with Greece, from that country, with their arts and philoſophy, they borrowed alſo their muſic and muſical inſtruments. No account, therefore, of Roman muſic is to be expected that would not be a repetition of what has been ſaid on the ſubject of the muſic of Greece.

18 Vanity of Nero with reſpect to muſic.

The exceſſive vanity of Nero with reſpect to muſic, diſplayed in his public contentions for ſuperiority with the moſt celebrated profeſſors of the art in Greece and Rome, is known to every one converſant in the hiſtory of Rome. The ſolicitude with which that deteſtable tyrant attended to his voice is curious, and will throw ſome light on the practices of ſingers in ancient times. He was in uſe to lie on his back, with a thin plate of lead on his ſtomach. He took frequent emetics and cathartics, abſtained from all kinds of fruit and ſuch meats as were held to be prejudicial to ſinging. Apprehenſive of injuring his voice, he at length deſiſted from haranguing the ſoldiery and the ſenate; and after his return from Greece eſtabliſhed an officer (Phonaſcus) to regulate his tones in ſpeaking.

19 Sacred muſic

Moſt nations have conſented in introducing muſic into their religious ceremonies. That art was early admitted into the rites of the Egyptians and Hebrews; and that it conſtituted a conſiderable part of the Grecian and Roman religious ſervice, appears from the writings of many ancient authors. The ſame pleaſing art ſoon obtained an introduction into the Chriſtian church, as the Acts of the Apoſtles diſcover in many paſſages. There remain no ſpecimens of the muſic employed in the worſhip of the primitive Chriſtians; but probably it was at firſt the ſame with that uſed in the Pagan rites of the Greeks and Romans. The practice of chanting the pſalms was introduced into the weſtern churches by St Ambroſe, about 350 years after Chriſt. In the year 600, the method of chanting was improved by St Gregory the Great. The Ambroſian chant contained four modes. In the Gregorian the number was doubled. So early as the age of Conſtantine the Great, prior to either of the periods laſt mentioned, when the Chriſtian religion firſt obtained the countenance of power, inſtrumental muſic came to be introduced into the ſervice of the church. In England, according to biſhop Stillingfleet, muſic was employed in the church-ſervice, firſt by St Auguſtine, and afterwards much improved by St Dunſtan, who was himſelf an eminent muſician, and who is ſaid to have firſt furniſhed the Engliſh churches and convents with the organ. The organ, the moſt majeſtic of all inſtruments, ſeems to have been an improvement of the hydraulican or water organ of the Greeks.—The firſt organ ſeen in France was ſent from Conſtantinople in 757, as a preſent to king Pepin from the emperor Conſtantine Copromymus VI. In Italy, Germany, and England, that inſtrument became frequent during the 10th century.

20 Introduced into the Engliſh church.

During the dark ages no work of genius or taſte in any department of ſcience ſeems to have been produced in any part of Europe; and except in Italy, where the cultivation of muſic was rather more the object of attention, that art was neglected equally with all others. There has always been obſerved a correſpondence in every country between the progreſs of muſic and the cultivation of other arts and ſciences. In the middle ages, therefore, when the moſt fertile provinces of Europe were occupied by the Goths, Huns, Vandals, and other barbarous tribes, whoſe language was as harſh as their manners were ſavage, little perfection and no improvement of muſic is to be looked for. Literature, arts, and refinements, were encouraged more early at the courts of the Roman pontiffs than in any other country; and owing to that circumſtance it is, that the ſcale, the counterpoint, the beſt melodies, the dramas religious and ſecular, the chief graces and elegancies of modern muſic, have derived their origin from Italy. In modern times, Italy has been to the reſt of Europe what ancient Greece was to Rome. The Italians have aided the civilization of their conquerors, and enlightened the minds of thoſe whoſe ſuperior proweſs had enſlaved them.

21 The great improvements in muſic had their origin in Italy.

Having mentioned counterpoint, it would be improper not to make one or two obſervations on an invention which is ſuppoſed to have been the ſource of great innovation in the practice of muſic. Counterpoint, or muſic in parts, ſeems to be an invention purely modern. The term harmony meant in the language of antiquity what is now underſtood by melody. Guido, a monk of Arezzo in Tuſcany, is, in the general opinion, ſuppoſed to have entertained the firſt idea of counterpoint about the year 1022: an art which, ſince his time, has experienced gradual and imperceptible improvements, far exceeding the powers or comprehenſion of any one individual. The term *counterpoint*, or *contra punctum*, denotes its own etymology and import. Muſical notation was at one time performed by ſmall points; and the preſent mode is only

22 Counterpoint.

(‡) Roſcius gained 500 ſeſtertia, or L. 4036 : 9 : 2 d. Sterling *per* annum.

only an improvement of that practice. Counterpoint, therefore, denotes the notation of harmony or music in parts, by points oppoſite to each other. The improvements of this important acquiſition to the art of muſic kept pace at firſt with thoſe of the organ; an inſtrument admirably adapted to harmony: And both the one and the other were till the 13th century employed chiefly in ſacred muſic. It was at this period that ſecular muſic began to be cultivated.

Before the invention of characters for time, muſic in parts muſt have conſiſted entirely of *ſimple counterpoint*, or note againſt note, as is ſtill practiſed in pſalmody. But the happy diſcovery of a time-table extended infinitely the powers of combined ſounds. The ancients had no other reſource to denote time and movement in muſic except two characters (— ⏑), equivalent to a long and a ſhort ſyllable. But time is of ſuch importance in muſic, that it can impart meaning and energy to the repetition of the ſame ſound: without it variety of tones has no effect with reſpect to gravity and acuteneſs. The invention of the time-table is attributed by almoſt all the writers on muſic of the laſt and preſent century to John de Muris, who flouriſhed about the year 1330. But in a manuſcript of John de Muris himſelf, bequeathed to the Vatican library by the Queen of Sweden, that honour ſeems to be yielded to Magiſter Franco, who appears to have been alive as late at leaſt as 1083. John de Muris, however, who there is ſome cauſe to believe was an Engliſhman, though not the inventor of the *cantus menſurabilis*, did certainly by his numerous writings greatly improve it. His tract on the *Art of Counterpoint* is the moſt clear and uſeful eſſay on the ſubject of which thoſe times can boaſt.

22 The invention of the time-table.

In the 11th century, during the firſt cruſade, Europe began to emerge from the barbarous ſtupidity and ignorance which had long overwhelmed it. While its inhabitants were exerciſing in Aſia every ſpecies of rapine and pious cruelty, art, ingenuity, and reaſon, inſenſibly civilized and ſoftened their minds. Then it was that the poets and ſongſters, known by the name of *Troubadours*, who firſt appeared in Provence, inſtituted a new profeſſion; which obtained the patronage of the count of Poictou, and many other princes and barons, who had themſelves cultivated muſic and poetry with ſucceſs. At the courts of their munificent patrons the troubadours were treated with reſpect. The ladies, whoſe charms they celebrated, gave them the moſt generous and flattering reception. The ſucceſs of ſome inſpired others with hopes, and excited exertions in the exerciſe of their art; impelling them towards perfection with a rapidity which the united force alone of emulation and emolument could occaſion. Theſe founders of modern verſification, conſtructing their ſongs on plans of their own Claſſical authority, either through ignorance or deſign, was entirely diſregarded. It does not appear, however, during the cultivation and favour of Provençal literature, that any one troubadour ſo far outſtripped the reſt as to become a model of imitation. The progreſs of taſte muſt ever be impeded by the ignorance and caprice of thoſe who cultivate an art without ſcience or principles.

23 Troubadours.

During almoſt two centuries after the arrangement of the ſcale attributed to Guido, and the invention of the time-table aſcribed to Franco, no remains of ſecular muſic can be diſcovered, except thoſe of the troubadours or Provençal poets. In the ſimple tunes of theſe bards no time indeed is marked, and but little variety of notation appears: it is not difficult, however, to diſcover in them the germs of the future melodies, as well as the poetry of France and Italy. Had the poetry and muſic of the troubadours been treated of in an agreeable manner by the writers who have choſen that ſubject, it would have been diſcovered to be worthy of attention: the poetry, as intereſting to literature; the melody to which it was ſung, as curious to the muſical hiſtorian.—Almoſt every ſpecies of Italian poetry is derived from the Provençals. *Air*, the moſt captivating part of ſecular vocal muſic, ſeems to have had the ſame origin. The moſt ancient ſtrains that have been ſpared by time, are ſuch as were ſet to the ſongs of the troubadours. The Provençal language began to be in favour with poets about the end of the 10th century. In the 12th it became the general vehicle, not only of poetry, but of proſe, to all who were ignorant of Latin. And theſe were not the laity only. At this period *violars*, or performers on the vielle or viol, *juglars* or flute-players, *muſars* or players on other inſtruments, and *comics* or comedians, abounded all over Europe. This ſwarm of poet-muſicians, who were formerly comprehended in France under the general title of *jongleurs*, travelled from province to province, ſinging their verſes at the courts of princes. They were rewarded with cloaths, horſes, arms, and money. Jongleurs or muſicians were employed often to ſing the verſes of troubadours, who themſelves happened to be deficient in voice or ignorant of muſic. The term *troubadour*, therefore, implies poetry as well as muſic. The jongleurs, menetriers, ſtrollers, or minſtrels, were frequently muſicians, without any pretenſions to poetry. Theſe laſt have been common at all times; but the troubadour or bard has diſtinguiſhed a particular profeſſion, either in ancient or modern times, only during the early dawnings of literature.

In the 13th century the ſongs were on various ſubjects; moral, merry, amorous: and at that time melody ſeems to have been little more than plain ſong or chanting. The notes were ſquare, and written on four lines only like thoſe of the Romiſh church in the cliff C, and without any marks for time. The movement and embelliſhments of the air depended on the abilities of the ſinger. Since that time, by the cultivation of the voice modern muſic has been much extended, for it was not till towards the end of St Lewis's reign that the fifth line began to be added to the ſtave. The ſinger always accompanied himſelf with an inſtrument in uniſon.

24 The harp the favourite inſtrument of the Troubadours.

As the lyre is the favourite inſtrument in Grecian poetry, ſo the harp held the ſame place in the eſtimation of the poets who flouriſhed in the period of which we at preſent ſpeak. A poet of the 14th century, Machau, wrote a poem on the ſubject of the harp alone; in which he aſſigns to each of its 25 ſtrings an allegorical name; calling one *liberality*, another *wealth*, &c.

25 The viol or violin.

The inſtrument which frequently accompanied, and indeed diſputed the pre-eminence with the harp, was the viol. Till the 16th century this inſtrument was furniſhed with frets; after that period it was reduced

to four ſtrings: and ſtill under the denomination of *violin* holds the firſt place among treble inſtruments. The viol was played with a bow, and differed entirely from the vielle, the tones of which were produced by the friction of a wheel; the wheel performed the part of a bow.

Britiſh harpers were famous long before the conqueſt. The bounty of William of Normandy to his *joculator* or bard is recorded in the Doomſday book. The harp ſeems to have been the favourite inſtrument in Britain for many ages, under the Britiſh, Saxon, Daniſh, and Norman kings. The *fiddle*, however, is mentioned ſo early as 1200 in the legendary life of St Chriſtopher. The ancient privileges of the minſtrels at the fairs of Cheſter are well known in the hiſtory of England.

The extirpation of the bards of Wales by Edward I. is likewiſe too familiar an incident to be mentioned here. His perſecuting ſpirit, however, ſeems to have been limited to that principality; for we learn, that at the ceremony of knighting his ſon, a *multitude of minſtrels* attended.

In 1315, during the reign of Edward II. ſuch extenſive privileges were claimed by the minſtrels, and ſo many diſſolute perſons aſſumed that character, that it became neceſſary to reſtrain them by expreſs laws.

The father of our genuine poetry, who in the 14th century enlarged our vocabulary, poliſhed our numbers, and with acquiſitions from France and Italy augmented our ſtore of knowledge (Chaucer), entitles one
26 St Cecilia. of his poems The Hiſtory of St Cecilia; and the celebrated patroneſs of muſic muſt no doubt be mentioned in a hiſtory of the art. Neither in Chaucer, however, nor in any of the hiſtories or legendary accounts of this Saint, does any thing appear to authoriſe the religious veneration paid to her by the votaries of muſic; nor is it eaſy to diſcover whence it has ariſen. As an incident relative to the period of which we ſpeak, it may be mentioned, that, according to
27 Origin of the degree of Mus. D. Spelmann, the appellation of *Doctor* was not among the degrees granted to graduates in England ſooner than the reign of King John, about 1207; although, in Wood's hiſtory of Oxford, that degree is ſaid to have been conferred, even in muſic, in the reign of Henry II. It is known that the title was created on the continent in the 12th century; and as, during the middle ages, muſic was always ranked among the ſeven liberal arts, it is likely that the degree was extended to it.

After the invention of printing, an art which has tended to diſſeminate knowledge with wonderful rapidity among mankind, muſic, and particularly counterpoint, became an object of high importance. The names of the moſt eminent compoſers who flouriſhed in England, from that time to the Reformation, were, Fairfax, William of Newark, Sheryngham, Turges, Baniſter, Tudor, Taverner, Tye, Johnſon, Parſons; to whom may be added John Marbeck, who ſet the whole Engliſh cathedral ſervice to muſic.

28 Scottiſh muſic. Before this period Scottiſh muſic had advanced to a high degree of perfection. James I. was a great compoſer of airs to his own verſes; and may be conſidered as the father of that plaintive melody which in Scotch tunes is ſo pleaſing to a taſte not vitiated by modern affectation. Beſides the teſtimony of *Fordun* and *Major*, who may be ſuſpected of being under the influence of national prejudice, we have that of Aleſſandro Teſſani, to the muſical ſkill of that accompliſhed prince. "Among us moderns (ſays this foreigner) we may reckon *James king of Scotland*, who not only compoſed many ſacred pieces of vocal muſic, but alſo of himſelf *invented a new kind of muſic, plaintive and melancholy, different from all others*; in which he has *been imitated* by Carlo Geſueldo prince of Venoſa, who in our age has improved muſic with new and admirable inventions."

Under ſuch a genius in poetry and muſic as king James I. it cannot be doubted that the national muſic muſt have been greatly improved. We have ſeen that he compoſed ſeveral anthems, or vocal pieces of *ſacred muſic*, which ſhows that his knowledge of the ſcience muſt have been very conſiderable. It is likewiſe known, that organs were by him introduced into the cathedrals and abbeys of Scotland, and choir-ſervice brought to ſuch a degree of perfection, as to fall little ſhort of that eſtabliſhed in any country of Europe.—By an able antiquary † of the preſent age, the great era of muſic, as of poetry, in Scotland, is ſuppoſed to have been from the beginning of the reign of James I. down to the end of the reign of James V. During that period flouriſhed *Gavin Douglas* biſhop of Dunkeld, *Ballenden* archdeacon of Murray, *Dunbar*, *Henryſon*, *Scott*, *Montgomery*, *Sir David Lindſey*, and many others, whoſe fine poems have been preſerved in Banatyne's Collection, and of which ſeveral have been publiſhed by Allan Ramſay in his *Evergeen*.

† See *Tyteler's Diſſertation on the Scotch Muſic*, vol. i. of the Tranſactions of the Society of Antiquaries in Scotland.

Before the Reformation, as there was but one religion, there was but one kind of ſacred muſic in Europe, plain chant, and the deſcant built upon it.—That muſic likewiſe was applied to one language only, the Latin. On that account, the compoſitions of Italy, France, Spain, Germany, Flanders, and England, kept pace in a great degree with each other in ſtyle and excellence. All the arts ſeem to have been the companions, if not the produce, of ſucceſsful commerce, and to have purſued the ſame courſe. Like commerce, they appeared firſt in Italy, then in the Hanſeatic towns, next in the Netherlands; and during the 16th century, when commerce became general, in every part of Europe.

29 In the 16th century muſic an indiſpenſable part of educa-tion. In the 16th century muſic was an indiſpenſable part of polite education; all the princes of Europe were inſtructed in that art. There is a collection preſerved in manuſcript called *Queen Elizabeth's Virginal Book*. If her majeſty was able to execute any of the pieces in that book, ſhe muſt have been a great player; a month's practice would not be ſufficient for any maſter now in Europe to enable him to play one of them to the end. *Tallis*, ſingularly profound in muſical compoſition, and *Bird* his admirable ſcholar, were two of the authors of this famous collection.

During the reign of Elizabeth, the genius and learning of the Britiſh muſicians were not inferior to any on the continent; an obſervation ſcarcely applicable at any other period of the hiſtory of this country. Sacred muſic was the principal object of ſtudy all over Europe.

The moſt eminent muſical theoriſts of Italy, who flouriſhed in the 16th century, were, Franchinus Gafierius, or Gafforio of Lode, Pietro Aaron of Florence,

30 Eminent muſicians in Italy during the 16th century.

rence, Lodovico Fogliano, Giov. Spataro, Giov. Maria da Terentio Lanfranco, Steffano Uanneo, Anton. Franciſco Done, Luigi Dentice, Nicolo Vicentino, and Gioſeffo Zarlino, the moſt general, voluminous, and celebrated theoriſt of that period.

Vincentio Galilei, a Florentine nobleman, and father of the great Galileo Galilei.

Maria Artuſe of Bologna, Oraſeo Tegrini, Pietro Pontio, and Lodovico Zacconi.

The principal Roman authors were, Giovanni Anmuccia, Giovanni Pierluigi da Paleſtrina, juſtly celebrated; Ruggiero Giovanelli, Luca Marenzio, who brought to perfection madrigals, the moſt cheerful ſpecies of ſecular muſic.

Of the Venetians, Adrian Willaeri is allowed to be at the head.

At the head of the Neapolitans is deſervedly placed Rocco Rodio.

At Naples, too, the illuſtrious dilettante, Don Carlo Geſualdo prince of Venoſa, is highly celebrated. He ſeems, however, to have owed much of his fame to his high rank.

Lombardy would alſo furniſh an ample liſt of eminent muſicians during the 16th century, of whom our limits will not admit of a particular enumeration:—The chief of them were, Conſtanzo Porta, Gaſtoldi, Biffi, Cima, Vocchi, and Monteverde.

At Bologna, beſides Artuſi already mentioned, Andrea Rota of the ſame city appears to have been an admirable contrapunctiſt.

Franciſco Corteccia, a celebrated organiſt and compoſer, and Aleſſandro Strigglio, a lutaneſt and voluminous compoſer, were the moſt eminent Florentines.

31 In Germany.

The inhabitans of the extenſive empire of Germany have long made muſic a part of general education.—They hold the place, next Italy, among the moſt ſucceſsful cultivators of the art. During the 16th century, their moſt eminent compoſers of muſic and writers on the ſubject were, Geo. Reiſchius, Michael Roſwick, Andreas Ornithorparchus, Paul Hofhaimer, Luſpeinius, Henry Loris or Lorit, Faber, Fink, Hofman, and many others whom it would be tedious to mention; and for a particular account of whoſe treatiſes and compoſitions we muſt refer to more voluminous hiſtories of muſic.

32 In France.

In France, during the 16th century, no art except the art of war made much progreſs in improvement.—Ronſard, Baif, Goudimel, Claud le Jeune, Caurroy, and Maudit, are the chief French muſicians of that period.

33 Spain.

In Spain, muſic was early received into the circle of ſciences in the univerſities. The muſical profeſſorſhip at Salamanca was founded and endowed by Alforzo the Wiſe, king of Caſtile.

One of the moſt celebrated of the Spaniſh muſicians was Francis Salinas, who had been blind from his infancy. He was a native of Burgos.

D. Criſtofero Morales, and Tomaſo Lodovico da Vittorio, deſerve likewiſe to be mentioned; and to mention them is all we can attempt; the purpoſe of which is, to excite more minute inquiry by thoſe who may chooſe to inveſtigate the ſubject particularly.

34 The Netherlands.

The Netherlands, likewiſe, during the period of which we have been ſpeaking, produced many eminent compoſers; of whom we may mention Verletot, Gombert, Arkadelt, Berchem, Richefort or Ricciafort, Crequilon Le Cock or Le Coq, Canis, Jacob Clemens Non Papa, Pierre Manchicourt, Baſton, Kerl, Rore, Orlando di Laſſo, and his ſons Ferdinand and Rodolph.

35 Muſical compoſers in England during the 17th century.

In the 17th century, the muſical writers and compoſers who acquired fame in England, were, Dr Nathanael Giles, Thomas Tomkins, and his ſon of the ſame name; Elway Bevin, Orlando Gibbons, Dr William Child, Adrian Batten, Martin Pierſon, William Lawes, Henry Lawes, Dr John Wilſon, John Hilton, John Playford, Captain Henry Cook, Pelham Humphrey, John Blow, William Turner, Dr Chriſtopher Gibbons, Benjamin Rogers, and Henry Purcell. Of theſe, Orlando Gibbons, Pelham Humphrey, and Henry Purcell, far excelled the reſt.

About the end of the reign of James I. a muſic-lecture or profeſſorſhip was founded in the univerſity of Oxford by Dr William Hychin.

In the reign of Charles I. a charter was granted to the muſicians of Weſtminſter, incorporating them, as the king's muſicians, into a body politic, with powers to proſecute and fine all who, except themſelves, ſhould "attempt to make any benefit or advantage of muſic in England or Wales:" powers which in the ſubſequent reign were put in execution.

About the end of the reign of Charles II. a paſſion ſeems to have been excited in England for the violin, and for pieces expreſsly compoſed for it, in the Italian manner (*). Prior to 1600, there was little other muſic except maſſes and madrigals, the two principal diviſions of ſacred and ſecular muſic; but from that time to the preſent, dramatic muſic becomes the chief object of attention. The muſic of the church and of the chamber continued indeed to be cultivated in Italy with diligence, and in a learned and elaborate ſtyle, till near the middle of the century; yet a revolution in favour of melody and expreſſion was preparing, even in ſacred muſic, by the ſucceſs of dramatic compoſition, conſiſting of recitation and melodies for a ſingle voice. Such melodies began now to be preferred to muſic of many parts; in which canons, fugues, and full harmony, had been the productions which chiefly employed the maſter's ſtudy and the hearer's attention.

36 Mean ſtate of the opera in the beginning of the preſent century.

So late as the beginning of the preſent century, according to Riccoboni, the performers in the operas of Germany, particularly at Hamburg, "were all tradeſmen or handicrafts; your ſhoemaker (ſays he) was often the firſt performer on the ſtage; and you might have bought fruit and ſweetmeats of the ſame girls,

(*) The moſt celebrated violin players of Italy, from the 16th century to the preſent time, have been Farina, M. Angelo Roſſi, Baſſani the violin-maſter of Corelli, the admirable Angelico Corelli himſelf, Torelli, Alberti, Albenoni, Teſſarini, Vivaldi, Geminiani one of the moſt diſtinguiſhed of Corelli's ſcholars, Tartini, Veracini, Barbella, Locatelli, Ferrari, Martini, Boccherini, and Giardini.

girls, whom the night before you had ſeen in the characters of Armida or Semiramis. Soon, however, the German opera aroſe to a more reſpectable ſituation; and even during the 17th century many eminent compoſers flouriſhed in that country.

The liſt of great muſicians which France produced during the early part of the ſame century is not numerous. Muſic ſeems to have been but little cultivated in that country, till the operas of Lulli, under the powerful patronage of Louis XIV. excited public attention.

The favourite ſinging-maſter and compoſer of France, about the middle of the 17th century, was Michael Lambert. John Baptiſt Lulli, ſoon after this time, roſe from the rank of a menial ſervant to fame, opulence, and nobility, by his ſkill in muſical compoſitions. The celebrated ſinger La Rochois was taught ſinging and acting by Lulli.

37 Curious anecdotes of a French ſinger.

La Maupin the ſucceſſor of La Rochois, on account of her extraordinary character and romantic adventures, deſerves to be mentioned. She was equally fond of both ſexes, fought and loved like a man, reſiſted and fell like a woman. She eloped from her huſband with a fencing-maſter, of whom ſhe learnt the ſmall ſword; ſhe became an excellent fencer. At Marſeilles ſhe became enamoured of a young lady, whom ſhe ſeduced: on account of this whimſical affection the lady was by her friends confined in a convent. La Maupin obtained admiſſion into the ſame convent as a novice: ſhe ſet fire to the convent, and in the confuſion carried off her favourite. At Paris, when ſhe appeared on the ſtage in 1695, Dumeni a ſinger having affronted her, ſhe put on mens clothes, and inſiſted on his drawing his ſword and fighting her: when he refuſed, ſhe caned him, and took from him his watch and ſnuff-box as trophies of her victory. At a ball given by Monſieur brother of Louis XIV. ſhe again put on mens clothes; and having behaved impertinently to a lady, three of the lady's friends, ſuppoſing the Maupin to be a man, called her out: ſhe killed them all; and returning coolly to the ball, told the ſtory to Monſieur, who obtained her pardon. She became afterwards miſtreſs to the elector of Bavaria. This prince quitting her for the counteſs of Arcos, ſent her by the count, huſband of that lady, a purſe of L. 40,000 livres: ſhe threw it at the count's head, telling him, it was a recompence worthy of ſuch a ſcoundrel and cuckold as himſelf. At laſt, ſeized with a fit of devotion, ſhe recalled her huſband, and ſpent the remainder of her life in piety. She died in 1707 at the age only of 34.

38 Chief compoſers for the church in England.

The Engliſh muſician whom we laſt mentioned was the celebrated Purcell: after his time the chief compoſers for the church were Clarke, Dr Holden, Dr Creyghton, Tucker, Aldrich, Golwin, Weldon, Dr Crofts, Dr Green, Boyce, and Nares; to whom may be added John Stanley, who attained high proficiency in muſic, although from two years old totally deprived of ſight.

The annals of modern muſic have hitherto furniſhed no event ſo important to the progreſs of the art as the invention of recitative or dramatic melody; a ſtyle of muſic which reſembles the manner of the ancient rhapſodiſts.

The *Orfeo* of Politian was the firſt attempt at muſical drama. It was afterwards perfected by Metaſtaſio. No muſical dramas ſimilar to thoſe afterwards known by the names of *opera* and *oratorio*, had exiſtence in Italy before the beginning of the 17th century. It was above the 1600, or a little before that time, that eunuchs were firſt employed for ſinging in Italy.

39 Firſt muſical drama.

There ſeem to have been no *ſinging* eunuchs in ancient times, unleſs the galli or archigalli, prieſts of Cybele, were ſuch. Caſtration has, however, at all times been practiſed in eaſtern countries, for the purpoſe of furniſhing to tyrannic jealouſy guards of female chaſtity; but never, ſo far as modern writers on the ſubject have diſcovered, merely to preſerve the voice, till about the end of the 16th century.

40 Firſt ſinging eunuchs.

At Rome, the firſt public theatre opened for the exhibition of muſical dramas, in modern times, was *il Torre de Nona*, where in 1671 Giaſone was performed. In 1679, the opera of *Dou è Amore*, ſet by the famous organiſt Bernardo Paſquini, was repreſented at *Nilla Sala de Signori Capranica*; a theatre which ſtill ſubſiſts. In the year 1680, *L'Oneſta negl'Amore* was exhibited; the firſt dramatic compoſition of the elegant, profound, and original Aleſſandro Scarlatti.

The inhabitants of Venice have cultivated and encouraged the muſical drama with more zeal and diligence than the reſt of Italy, during the end of the laſt and beginning of the preſent century; yet the opera was not eſtabliſhed in Venice before the year 1637; in that year the firſt regular drama was performed: it was Andromeda.

41 Opera of Berenice.

In 1680 the opera of Berenice was exhibited at Padua with ſuch aſtoniſhing ſplendour as to merit notice. There were choruſes of 100 virgins, 100 ſoldiers, 100 horſemen in iron armour, 40 cornets of horſe, 6 trumpeters on horſeback, 6 drummers, 6 enſigns, 6 ſackbuts, 6 great flutes, 6 minſtrels playing on Turkiſh inſtruments, 6 others on octave flutes, 6 pages, 3 ſergeants, 6 cymbaliſts. There were 12 huntſmen, 12 grooms, 6 coachmen for the triumph, 6 others for the proceſſion, 2 lions led by two Turks, 2 elephants by two others; Berenice's triumphal car drawn by 4 horſes, 6 other cars with priſoners and ſpoils drawn by 12 horſes, 6 coaches. Among the ſcenes and repreſentations in the firſt act were, a vaſt plain with two triumphal arches, another plain with pavilions and tents, and a foreſt for the chace: in act third, the royal dreſſing-room completely furniſhed, ſtables with 100 live horſes, portico adorned with tapeſtry, and a ſtupendous palace in perſpective. At the end of the firſt act were repreſentations of every kind of chace, wild boar, ſtag, deer, bears. At the end of the third act, an enormous globe, deſcended as from the ſky, divided itſelf into other globes ſuſpended in the air, and ornamented with emblematical figures of time, fame, honour, &c.

Early in the laſt century, machinery and decoration uſurped the importance due to poetry and muſic in ſuch exhibitions.

Few inſtances occur of muſical dramas at Naples till the beginning of the preſent century. Before the time of the elder Scarlatti, it ſeems as if Naples had been leſs fertile in great contrapuntiſts, and leſs diligent in the cultivation of dramatic muſic, than any other ſtate of Italy. Since that time all the reſt of

Europe

Europe has been furniſhed with compoſers and performers from that city.

42 French and Engliſh opera.

The word *opera* ſeems to have been familiar to Engliſh poets from the beginning of the laſt century. *Stilo recitativo*, a recent innovation even in Italy, is mentioned by Ben Johnſon ſo early as 1617. From this time it was uſed in maſques, occaſionally in plays, and in cantatas, before a regular drama wholely ſet to muſic was attempted. By the united abilities of Quinault and Lulli, the opera in France had ariſen to high favour. This circumſtance afforded encouragement to ſeveral attempts at dramatic muſic in England by Sir William D'Avenant and others, before the muſic, language, or performers of Italy were employed on our ſtage. Pieces, ſtyled *dramatic operas*, preceded the Italian opera on the ſtage of England. Theſe were written in Engliſh, and exhibited with a profuſe decoration of ſcenery and habits, and with the beſt ſingers and dancers that could be procured: Pſyche and Circe, are entertainments of this kind: the Tempeſt and Macbeth were acted with the ſame accompaniments.

During the 17th century, whatever attempts were made in muſical drama, the language ſung was always Engliſh. About the end of that century, however, Italian ſinging began to be encouraged, and vocal as well as inſtrumental muſicians from that country began to appear in London.

The firſt muſical drama, performed wholly after the Italian manner in recitative for the dialogue or narrative parts, and meaſured melody for the airs, was Arſinoe queen of Cyprus, tranſlated from an Italian opera of the ſame name, written by Stanzani of Bologna. The Engliſh verſion of this opera was ſet to muſic by Thomas Clayton, one of the royal band, in the reign of William and Mary. The ſingers were all Engliſh, Meſſrs Hughes, Leveredge, and Cook; Mrs Tofts, Mrs Croſs, and Mrs Lyndſey. The tranſlation of Arſinoe, and the muſic to which it is ſet, are execrable; yet ſuch is the charm of novelty, that this miſerable performance, deſerving neither the name of a drama by its poetry, nor of an opera by its muſic, ſuſtained 24 repreſentations, and the ſecond year 11.

Operas, notwithſtanding their deficiences in poetry, muſic, and performance (no foreign compoſer or eminent ſinger having yet arrived), became ſo formidable to our actors at the theatres, that it appears from the Daily Courant, 14th January 1707, a ſubſcription was opened "for the encouragement of the comedians acting in the Haymarket, and to enable them to keep the diverſion of plays under a ſeparate intereſt from operas."

Mr Addiſon's opera of Roſamond appeared about this time; but the muſic ſet by Clayton is ſo contemptible, that the merit of the poetry, however great, could not of itſelf long ſupport the piece. The choice of ſo mean a compoſer as Clayton, and Mr Addiſon's partiality to his abilities, betray a want of muſical taſte in that elegant author.

The firſt truly great ſinger who appeared on the ſtage of Britain was *Cavalier Nicolino Grimaldi*, commonly known by the name of *Nicolini*. He was a Neapolitan; and though a beautiful ſinger indeed, was ſtill more eminent as an actor. In the Tatler, nº 115. the elegance and propriety of his action are particularly deſcribed †. Recently before his appearance, *Valentini Urbani*, and a female ſinger called *The Baroneſs*, arrived. Margarita de l'Epini, who afterwards married Dr Pepuſch, had been in this country ſome time before.

† See alſo *Spectator*, vol. i. nº 13.

The firſt opera performed *wholly in Italian*, and *by Italian ſingers*, was *Almahide*. As at preſent, ſo at that time, operas were generally performed twice a-week.

43 Arrival of Handel in England.

The year 1710 is diſtinguiſhed in the annals of muſic by the arrival in Britain of George Frederick Handel. Handel had been in the ſervice of the elector of Hanover, and came firſt to England on a viſit of curioſity. The fame of this great muſician had penetrated into this country before he himſelf arrived in it; and Aaron Hill, then in the direction of the Haymarket theatre, inſtantly applied to him to compoſe an opera. It was Rinaldo; the admirable muſic of which he produced entirely in a fortnight. Soon after this period appeared, for the firſt time as an opera ſinger, the celebrated Mrs Anaſtaſia Robinſon. Mrs Robinſon, who was the daughter of a portrait painter, made her firſt public exhibitions in the concerts at York-buildings; and acquired ſo much the public favour, that her father was encouraged to take a houſe in Golden Square, for the purpoſe of eſtabliſhing weekly concerts and aſſemblies, in the manner of *Converſazioni*, which became the reſort of the moſt polite audiences.

Soon after Mrs Robinſon accepted of an engagement at the Opera, where her ſalary is ſaid to have been L. 1000, and her other emoluments equal to that ſum. She quitted the ſtage in conſequence of her marriage with the gallant earl of Peterborough, the friend of Pope and Swift. The eminent virtues and accompliſhments of this lady, who died a few years ago at the age of 88, entitled her to be mentioned even in a compend too ſhort for biography. The conducting of the opera having been found to be more expenſive than profitable, it was entirely ſuſpended from 1717 till 1720, when a fund of L. 50,000 for ſupporting and carrying it on was ſubſcribed by the firſt perſonages of the kingdom. The ſubſcribers, of whom king George I. was one for L. 1000, were formed into a ſociety, and named *The Royal Academy of Muſic*. Handel was commiſſioned to engage the performers: for that purpoſe he went to Dreſden, where Italian operas were at that time performed in the moſt ſplendid manner at the court of Auguſtus elector of Saxony, then king of Poland. Here Handel engaged Seneſino-Berenſtadt, Boſchi, and the Duranſtanti.

44 Progreſs of the opera under his management.

In the 1723, the celebrated Franceſca Cuzzoni appeared as a firſt-rate ſinger; and two years afterwards arrived her diſtinguiſhed rival Signora Fauſtina Bordoni.

In a cantabile air, though the notes Cuzzoni added were few, ſhe never loſt an apportunity of enriching the cantilena with the moſt beautiful embelliſhments. Her ſhake was perfect. She poſſeſſed a creative fancy; and ſhe enjoyed the power of occaſionally accelerating and retarding the meaſure in the moſt artificial and able manner, by what is in Italy called *tempo rubato*. Her high notes were unrivalled in clearneſs and ſweetneſs. Her intonations were ſo juſt and ſo fixed, that

it ſeemed as if ſhe had not the power to ſing out of tune.

Fauſtina Bordoni, wife of the celebrated Saxon compoſer Haſſe, invented a new kind of ſinging, by running diviſions, with a neatneſs and velocity which aſtoniſhed all who heard her. By taking her breath imperceptibly, ſhe had the art of ſuſtaining a note apparently longer than any other ſinger. Her beats and trills were ſtrong and rapid; her intonation perfect. Her profeſſional perfections were enhanced by a beautiful face, fine ſymmetry of figure, and a countenance and geſture on the ſtage which indicated an entire intelligence and poſſeſſion of the ſeveral parts allotted to her.

Theſe two angelic performers excited ſo ſignally the attention of the public, that a party ſpirit between the abettors of the one and of the other was formed, as violent and as inveterate almoſt as any of thoſe that had ever occurred relative to matters either theological or political; yet ſo diſtinct were their ſtyles of ſinging, ſo different their talents, that the praiſe of the one was no reproach to the other.

In leſs than ſeven years, the whole L. 50,000 ſubſcribed by the Royal Academy, beſides the produce of admiſſion to non-ſubſcribers, was expended, and the governor and directors of the ſociety relinquiſhed the idea of continuing their engagements; conſequently, at the cloſe of the ſeaſon 1727, the whole band of ſingers diſperſed. The next year we find Seneſino, Fauſtina, Balde, Cuzzoni, Nicolini, Farinelli, and Boſche, at Venice.

Handel, however, at his own riſk, after a ſuſpenſion of about a twelvemonth, determined to recommence the Opera; and accordingly engaged a band of performers entirely new. Theſe were Signor Bernacchi, Signora Merighi, Signora Strada, Signor Anibale Pio Fabri, his wife, Signora Bertoldi, and John Godfrid Reimſchneider.

45 Invention of the oratorio, and its introduction into England.

The ſacred muſical drama, or oratorio, was invented early in the 14th century. Every nation in Europe ſeems firſt to have had recourſe to religious ſubjects for dramatic exhibitions. The oratorios had been common in Italy during the laſt century; they had never been *publicly* introduced in England till Handel, ſtimulated by the rivalſhip of other adventurers, exhibited in 1732 his oratorios of Eſther, and of Acis, and Galatea, the laſt of which he had compoſed twelve years before for the duke of Chandos's chapel at Cannons. The moſt formidable oppoſition which Handel met with in his conduct of the Italian opera was a new theatre for exhibiting theſe operas, opened by ſubſcription in Lincoln's-inn Fields, under the conduct of Nicola Porpora, a reſpectable compoſer. A difference having occurred between Handel and Seneſino, Seneſino had for ſome time deſerted the Haymarket, where Handel managed, and was now engaged at the rival theatre of Lincoln's-inn Fields. To ſupply the place of Seneſino, Handel brought over *Giovanni Careſtini*, a ſinger of the moſt extenſive powers. His voice was at firſt a powerful and clear ſoprano; afterwards it changed into the fulleſt, fineſt, deepeſt, counter-tenor that has perhaps ever been heard. Careſtini's perſon was tall, beautiful, and majeſtic. He rendered every thing he ſung intereſting by energy, taſte, and judicious embelliſhment. In the execution of difficult diviſions from the cheſt, his manner was articulate and admirable. It was the opinion of Haſſe, as well as other eminent profeſſors, that whoever had not heard Careſtini, was unacquainted with the moſt perfect ſtyle of ſinging. The opera under the direction of Porpora was removed to the Haymarket, which Handel had left. Handel occupied the theatre of Lincoln's-inn Fields; but his rivals now acquired a vaſt advantage of attraction, by the acceſſion of Carlo Broſchi detto Farinelli to their party, who at this time arrived. This renowned ſinger ſeems to have tranſcended the limits of all anterior vocal excellence. No vocal performer of the preſent century has been ſo unanimouſly allowed to poſſeſs an uncommon power, ſweetneſs, extent, and agility of voice, as Farinelli. Nicolini, Seneſino, and Careſtini, gratified the eye as much by the dignity, grace, and propriety of their action and deportment, as the ear, by the judicious uſe of a few notes within the limits of a ſmall compaſs of voice; but Farinelli, without the aſſiſtance of ſignificant geſtures or graceful attitudes, enchanted and aſtoniſhed his hearers, by the force, extent, and melliſluous tones of the mere organ, when he had nothing to execute, articulate, or expreſs. Though during the time of ſinging he was as motionleſs as a ſtatue, his voice was ſo active that no intervals were too cloſe, too wide, or too rapid, for his execution.

Handel having loſt a great part of his fortune by the opera, was under the neceſſity of trying the public gratitude in a benefit, which was not diſgraced by the event: the theatre, for the honour of the nation, was ſo crowded, that he is ſaid to have cleared L. 800.

46 Opera in England given up.

After a fruitleſs attempt by Heidegger, the coadjutor of Handel in the conduct of the opera, and patentee of the King's Theatre in Haymarket, to procure a ſubſcription for continuing it, it was found neceſſary to give up the undertaking.

It was about this time that the ſtatue of Handel was erected in Vauxhall, at the expence of Mr Tyers, proprietor of thoſe gardens.

47 Revived.

The next year (1739) Handel carried on oratorios at the Haymarket, as the opera there was ſuſpended. The earl of Middleſex now undertook the troubleſome office of *impreſario* of the Italian opera. He engaged the King's theatre, with a band of ſingers from the Continent almoſt entirely new. Caluppi was his compoſer. Handel, almoſt ruined, retired at this time to Ireland, where he remained a conſiderable time. In 1744 he again attempted oratorios at the King's theatre, which was then, and till 1746, unoccupied by the opera, on account of the rebellion.

The arrival of Giardini in London this year forms a memorable æra in the inſtrumental muſic of England. His powers on the violin were unequalled. The ſame year Dr Croza, then manager of the opera, eloped, leaving the performers, and innumerable trades-people, his creditors. This incident put an end to operas of all kinds for ſome time.

This year a comic opera, called *Il Filoſofo di Campagna*, compoſed by Caluppi, was exhibited, which ſurpaſſed in muſical merit all the comic operas performed in England till the *Bicona Figliula*. Signora Paganini acquired ſuch fame by the airs allotted to her in that piece, that the crowds at her benefit were beyond example. Caps were loſt, gowns torn in

pieces, and ladies in full dreſs, without ſervants or carriages, were obliged to walk home, amidſt the merriment of the ſpectators on the ſtreets.

48 1764 and 1765, Manzoli. At this period the arrival of Giovanni Manzoli marked a ſplendid æra in the annals of muſical drama, by conferring on ſerious opera a degree of importance to which it had ſeldom yet ariſen ſince its eſtabliſhment in England. Manzoli's voice was the moſt powerful and voluminous ſoprano that had been heard ſince the time of Farinelli: his manner of ſinging was grand, and full of taſte and dignity.

49 Tenducci. At this time Tenducci, who had been in England ſome time before, and was now returned much improved, performed in the ſtation of ſecond man to Manzoli.

50 1769. Guadagni. Gaetano Guadagni made a great figure at this time. He had been in this country early in life (1748), as ſerious man in a burletta troop of ſingers. His voice was then a full and well-toned counter-tenor; but he ſung wildly and careleſsly. The excellence of his voice, however, attracted the notice of Handel, who aſſigned him the parts in his oratorios the Meſſiah and Samſon, which had been originally compoſed for Mrs Cibber. He quitted London for the firſt time about 1753. The higheſt expectations of his abilities were raiſed by fame before his ſecond arrival, at the time of which we treat. As an actor he ſeems to have had no equal on any ſtage in Europe. His figure was uncommonly elegant and noble; his countenance replete with beauty, intelligence, and dignity; his attitudes were full of grace and propriety. Thoſe who remembered his voice when formerly in England were now diſappointed: it was comparatively thin and feeble; he had now changed it to a ſoprano, and extended its compaſs from ſix or ſeven notes to fourteen or fifteen. The muſic he ſung was the moſt ſimple imaginable; a few notes with frequent pauſes, and opportunities of being liberated from the compoſer and the band, were all he required. In theſe effuſions, ſeemingly extemporaneous, he diſplayed the native power of melody unaided by harmony or even by uniſonous accompaniment: the pleaſure he communicated proceeded principally from his artful manner of diminiſhing the tones of his voice, like the dying notes of the Æolian harp. Moſt other ſingers affect a ſwell, or *meſſa de voce;* but Guadagni, after beginning a note with force, attenuated it ſo delicately that it poſſeſſed all the effect of extreme diſtance. During the ſeaſon 1770 and 1771, Tenducci was the immediate ſucceſſor of Guadagni. This performer, who appeared in England firſt only as a ſinger of the ſecond or third claſs, was during his reſidence in Scotland and Ireland ſo much improved as to be well received as firſt man, not only on the ſtage of London but in all the great theatres of Italy.

It was during this period that dancing ſeemed firſt to gain the aſcendant over muſic by the ſuperior talents of Mademoiſelle Heinel, whoſe grace and execution were ſo perfect as to eclipſe all other excellence.

51 1773. Miſs Davies. In the firſt opera performed this ſeaſon (*Lucco Vero*) appeared Miſs Cecilia Davies, known in Italy by the name of L'Ingleſina. Miſs Davies had the honour of being the firſt Engliſh woman who had ever been thought worthy of ſinging on any ſtage in Italy. She even performed with eclat the principal female characters on many of the great theatres of that country. Gabrielli only on the Continent was ſaid to ſurpaſs her. Her voice, though not of great volume, was clear and perfectly in tune; her ſhake was open and diſtinct, without the ſluggiſhneſs of the French cadence. The flexibility of her throat rendered her execution equal to the moſt rapid diviſions.

Next ſeaſon introduced Venanzio Ravygini, a beautiful and animated young man; a compoſer as well as a ſinger.—His voice was ſweet, clear, flexible; in compaſs more than two octaves.

52 Caterina Gabrielli. The ſeaſon 1775 and 1776 was rendered memorable by the arrival of the celebrated *Caterina Gabrielli*, ſtyled early in life *La Cuochetina*, being the daughter of a cardinal's cook at Rome. She had, however, in her countenance and deportment no indications of low birth. Her manner and appearance depicted dignity and grace. So great was her reputation before her arrival in England for ſinging and for caprice, that the public expecting perhaps in both too much, were unwilling to allow her due praiſe for her performance, and were apt to aſcribe every thing ſhe did to pride and inſolence. Her voice, though exquiſite, was not very powerful. Her chief excellence having been the neatneſs and rapidity of her execution, the ſurpriſe of the public muſt have been much diminiſhed on hearing her after Miſs Davies, who ſung many of the ſame ſongs in the ſame ſtyle, and with a neatneſs ſo nearly equal, that common hearers could diſtinguiſh no difference. The diſcriminating critic, however, might have diſcovered a ſuperior ſweetneſs in the natural tone of the Gabrielli's voice, an elegance in the finiſhing of her muſical periods or paſſages, an accent and preciſion in her diviſions, ſuperior not only to Miſs Davies, but to every other ſinger of her time. In ſlow movements her pathetic powers, like thoſe in general of performers moſt renowned for agility, were not exquiſitely touching. She now reſides at Bologna.

53 Agujari at the Pantheon. About the time of which we have been treating, the proprietors of the Pantheon ventured to engage the *Agujari* at the enormous ſalary of L. 100 *per* night, for ſinging two ſongs only! *Lucrezia Agujari* was a truly wonderful performer. The lower part of her voice was full, round, and of excellent quality; its compaſs amazing. She had two octaves of fair natural voice, from A on the fifth line in the baſs to A on the ſixth line in the treble, and beyond that in *alt* ſhe had in early youth more than another octave. She has been heard to aſcend to B b *in altiſſimo*. Her ſhake was open and perfect; her intonation true; her execution marked and rapid; the ſtyle of her ſinging, in the natural compaſs of her voice, grand and majeſtic.

54 Anna Pozzi In 1776 arrived Anna Pozzi, as ſucceſſor to the Gabrielli. She poſſeſſed a voice clear, ſweet, and powerful; but her inexperience, both as an actreſs and as a ſinger, produced a contraſt very unfavourable to her when compared with ſo celebrated a performer as Gabrielli. Since that time, however, Pozzi, with more ſtudy and knowledge, has become one of the beſt and moſt admired female ſingers in Italy.

After the departure of Agujari for the ſecond and laſt time, the managers of the Pantheon engaged the *Georgi* as her ſucceſſor. Her voice was exquiſitely fine, 55 Georgi but

but totally uncultivated. She is now employed as the first woman in the operas of the principal cities of Italy.

56 Roncaglia and Danze.

During the seasons 1777 and 1778, the principal singers at the opera in London were Frandesco Roncaglia and Franceſca Danze, afterwards Madame Le Brun.

Roncaglia poſſeſſed a ſweet-toned voice; but of the three great requiſites of a complete ſtage-ſinger, pathos, grace, and execution, which the Italians call *cantabile*, *grazioſa*, and *bravura*, he could lay claim only to the ſecond. His voice, a *voce de camera*, when confined to the *grazioſa* in a room, leaves nothing to wiſh for.

Danze had a voice well in tune, a good ſhake, great execution, prodigious compaſs, with great knowledge of muſic; yet the pleaſure her performance imparted was not equal to theſe accompliſhments: but her object was not ſo much pathos and grace, as to ſurpriſe by the imitation of the tone and difficulties of inſtruments.

57 Pacchierotti.

This year *Gaſparo Pacchierotti* appeared in London, whither his high reputation had penetrated long before. The natural tone of his voice is intereſting, ſweet, and pathetic. His compaſs downwards is great, with an aſcent up to B b, and ſometimes to C *in alt.* He poſſeſſes an unbounded fancy, and the power not only of executing the moſt difficult and refined paſſages, but of inventing embelliſhment entirely new. *Ferdinando Bertoni*, a well-known compoſer, came along with Pacchierotti to Britain.

58 Dancing gains the aſcendant over muſic at the opera-houſe.

During the laſt ten years, dancing has become an important branch of the amuſements of the opera-houſe. Mademoiſelle Heinel, M. Veſtris le Jeune, Mademoiſelle Baccelli, had, during ſome years, delighted the audience at the opera; but on the arrival of M. Veſtris l'Ainè, pleaſure was exchanged for ecſtaſy. In the year 1781, Pacchierotti had by this time been ſo frequently heard that his ſinging was no impediment to converſation; but while the elder Veſtris was on the ſtage, not a breathing was to be heard. Thoſe lovers of muſic who talked the loudeſt while Pacchierotti ſung, were in agonies of terror leſt the graceful movements of Veſtris, *le dieu de la dance*, ſhould be diſturbed by audible approbation. Since that time, the moſt mute and reſpectful attention has been paid to the manly grace of Le Picq, and the light fantaſtic toe of the younger Veſtris; to the Roſſis, the Theodores, the Coulons, the Hillingſburgs; while the ſlighted ſingers have been diſturbed, not by the violence of applauſe, but the clamour of inattention.

59 Commemoration of Handel in Weſtminſter Abbey.

The year 1784 was rendered a memorable era in the annals of muſic by the ſplendid and magnificent manner in which the birth and genius of Handel were celebrated in Weſtminſter Abbey and the Pantheon, by five performances of pieces ſelected from his own works, and executed by a band of more than 500 voices and inſtruments, in the preſence and under the immediate auſpices of their majeſties and the firſt perſonages of the kingdom. The commemoration of Handel has been ſince eſtabliſhed as an annual muſical feſtival for charitable purpoſes; in which the number of performers and the perfection of the performances have continued to increaſe. In 1785 the band, vocal and inſtrumental, amounted to 616; in 1786 to 741; in 1787 to 806.

Dr Burney publiſhed An Account of the Muſical Performances in Commemoration of Handel, for the benefit of the Muſical Fund. The members and guardians of that fund are now incorporated under the title of *Royal Society of Muſicians*. See HANDEL.

This year Pacchierotti and his friend Bertoni left England. About the ſame time our country was deprived of the eminent compoſer Sacchini, and Giardini the greateſt performer on the violin then in Europe.

60 Excellence of Madam Mara.

As a compenſation for theſe loſſes, this memorable year is diſtinguiſhed by the arrival of Madam Mara, whoſe performance in the commemoration of Handel in Weſtminſter Abbey inſpired an audience of 3000 of the firſt people of the kingdom, not only with pleaſure but with ecſtaſy and rapture.

61 Rubinelli.

In 1786 arrived *Giovanni Rubinelli*. His voice is a true and full contralto from C in the middle of the ſcale to the octave above. His ſtyle is grand; his execution neat and diſtinct; his taſte and embelliſhments new, ſelect, and maſterly.

62 A new dance by M. Noverre.

In 1788 a new dance, compoſed by the celebrated M. Noverre, called *Cupid and Pſyche*, was exhibited along with the opera *La Locandiera*, which produced an effect ſo uncommon as to deſerve notice. So great was the pleaſure it afforded to the ſpectators, that Noverre was unanimouſly brought on the ſtage and crowned with laurel by the principal performers. This, though common in France, was a new mark of approbation in England.

63 Marcheſi.

This year arrived Signor Luige Marcheſi, a ſinger whoſe talents have been the ſubject of praiſe and admiration on every great theatre of Europe. Marcheſi's ſtyle of ſinging is not only elegant and refined in an uncommon degree, but often grand and full of dignity, particularly in his recitative and occaſional low notes. His variety of embelliſhment and facility of running extempore diviſions are wonderful. Many of his graces are elegant and of his own invention.

64 Diſcriminated characters of Pacchierotti, Rubinelli, and Marcheſi.

The three greateſt Italian ſingers of the preſent times are certainly Pacchierotti, Rubinelli, and Marcheſi. In diſcriminating the ſeveral excellencies of theſe great performers, a very reſpectable judge, Dr Burney, has particularly praiſed the ſweet and touching voice of Pacchierotti; his fine ſhake, his exquiſite taſte, his great fancy, and his divine expreſſion in pathetic ſongs: Of Rubinelli's voice, the fulneſs, ſteadineſs, and majeſty, the accuracy of his intonations, his judicious graces: Of Marcheſi's voice, the elegance and flexibility, his grandeur in recitative, and his boundleſs fancy and embelliſhments.—Having mentioned Dr Burney, we are in juſtice bound to acknowledge the aid we have derived from his hiſtory; a work which we greatly prefer to every other modern production on the ſubject. During the latter part of the preſent century many eminent compoſers have flouriſhed on the continent; ſuch as Jomelli, the family of the Bachs, Gluck, Haydn, and many others, whoſe different ſtyles and excellencies would well deſerve to be particulariſed, would our limits permit. With the ſame regard to brevity, we can do no more than juſt mention the late king of Pruſſia, the late elector of Bavaria, and prince Lobkowitz, as eminent dilettanti of modern times.

65 Sovereign princes dilettanti.

Beſides the opera-ſingers whom we have mentioned, our

66 Singers on theatres and in public gardens.

our theatres and public gardens have exhibited ſingers of conſiderable merit. In 1730 Miſs Rafter, afterwards the celebrated Mrs Clive, firſt appeared on the ſtage at Drury-lane as a ſinger. The ſame year introduced Miſs Cecilia Young, afterward the wife of Dr Arne. Her ſtyle of ſinging was infinitely ſuperior to that of any other Engliſh woman of her time.

67 Favourite muſicians.

Our favourite muſicians at this time were, Dubourg, Clegg, Clarke, and Feſting, on the violin; Kytch on the hautboy; Jack Feſting on the German flute; Baſton on the common flute; Karba on the baſſoon; Valentine Snow on the trumpet: and on the organ, Roſeingrave, Green, Robinſon, Magnus, Jack James, and the blind Stanley, who ſeems to have been preferred. The favourite playhouſe ſinger was Salway; and at concerts Mountier of Chicheſter.

As compoſers for our national theatre, Pepuſch and Galliard ſeem to have been unrivalled till 1732; when two competitors appeared, who were long in poſſeſſion of the public favour: We allude to John Frederick Lampe and Thomas Auguſtus Arne.

In 1736 Mrs Cibber, who had captivated every hearer of ſenſibility by her native ſweetneſs of voice and powers of expreſſion as a ſinger, made her firſt attempt as a tragic actreſs. The ſame year Beard became a favourite ſinger at Covent-garden. At this time Miſs Young, afterwards Mrs Arne, and her two ſiſters Iſabella and Eſther, were the favourite Engliſh female ſingers.

68 Fund for decayed muſicians.

In 1738 was inſtituted the fund for the ſupport of decayed muſicians and their families.

It was in 1745 that Mr Tyers, proprietor of Vauxhall gardens, firſt added vocal muſic to the other entertainments of that place. A ſhort time before Ranelagh had become a place of public amuſement.

69 Arrival of Giardini.

In 1749 arrived Giardini, whoſe great taſte, hand, and ſtyle in playing on the violin, procured him univerſal admiration. A few years after his arrival he formed a morning *academia* or concert at his houſe, compoſed chiefly of his ſcholars.

About this time San Martini and Charles Aviſon were eminent compoſers.

70 Style of Arne.

Of near 150 muſical pieces brought on our national theatres within theſe 40 years, 30 of them at leaſt were ſet by Arne. The ſtyle of this compoſer, if analyſed, would perhaps appear to be neither Italian nor Engliſh; but an agreeable mixture of both and of Scotch.

71 The earl of Kelly.

The late earl of Kelly, who died but a few years ago, deſerves particular notice, as poſſeſſed of a very eminent degree of muſical ſcience, far ſuperior to other dilettanti, and perhaps not inferior to any profeſſor of his time. There was no part of theoretical or practical muſic in which he was not thoroughly verſed: He poſſeſſed a ſtrength of hand on the violin, and a genius for compoſition, with which few profeſſors are gifted.

72 Abel.

Charles Frederic Abel was an admirable muſician: his performance on the viol da gamba was in every particular complete and perfect. He had a hand which no difficulties could embarraſs; a taſte the moſt refined and delicate; a judgment ſo correct and certain as never to permit a ſingle note to eſcape him without meaning. His compoſitions were eaſy and elegantly ſimple. In writing and playing an *adagio* he was ſuperior to all praiſe; the moſt pleaſing yet learned modulation, the richeſt harmony, the moſt elegant and poliſhed melody, were all expreſſed with the moſt exquiſite feeling, taſte, and ſcience. His manner of playing an adagio ſoon became the model of imitation for all our young performers on bowed inſtruments. Bartholemon, Cervetto, Cramer, and Croſdil, may in this reſpect be ranked as of his ſchool. All lovers of muſic muſt have lamented that Abel in youth had not attached himſelf to an inſtrument more worthy of his genius, taſte, and learning, than the viol da gamba, that remnant of the old cheſt of viols which during the laſt century was a neceſſary appendage of a nobleman's or gentleman's family throughout Europe, previous to the admiſſion of violins, tenors, and baſes, in private houſes or public concerts. Since the death of the late elector of Bavaria, who was next to Abel (the beſt performer on the viol da gamba in Europe), the inſtrument ſeems quite laid aſide. It was uſed longer in Germany than elſewhere; but the place of gambiſt ſeems now as much ſuppreſſed in the chapels of German princes as that of lutaniſts. The celebrated performer on the violin, Lolle, came to England in 1785. Such was his caprice, that he was ſeldom heard; and ſo eccentric was his ſtyle and compoſition, that by many he was regarded as a madman. He was, however, during his lucid intervals a very great and expreſſive performer in the ſerious ſtyle.

73 Mrs Billington.

Mrs Billington, after diſtinguiſhing herſelf in childhood as a neat and expreſſive performer on the piano-forte, appeared all at once in 1786 as a ſweet and captivating ſinger. In emulation of the Mara and other great bravura ſingers, ſhe at firſt too frequently attempted paſſages of difficulty; now, however, ſo greatly has ſhe improved, that no ſong ſeems too high or too rapid for her execution. The natural tone of her voice is ſo exquiſitely ſweet, her knowledge of muſic ſo conſiderable, her ſhake ſo true, her cloſes and embelliſhments ſo various, her expreſſions ſo grateful, that envy only or apathy could hear her without delight. The preſent compoſers, and performers of the firſt claſs, are ſo well known to the lovers of the art, that it would be needleſs and improper to mention them particularly: and to deſcribe the diſtinctive powers of Bartholemon, Cramer, Pieltain, Raimonde, and Salamon, would be too delicate a taſk for us to undertake.

[73] The catch-club and the concert of ancient muſic.

The Catch-club at the Thatched Houſe, inſtituted in 1762 by the late earl of Eglinton, the preſent duke of Queenſberry, and others; and the concert of ancient muſic, ſuggeſted by the earl of Sandwich in 1776, have had a beneficial effect in improving the art.

We have been ſomewhat particular in our account of muſical affairs in our own country during the preſent century, as what would be moſt intereſting to general readers, and of which a well-informed gentleman would not wiſh to be ignorant. The profeſſor and connoiſſeur is not to be expected to content himſelf with diſquiſitions much more minute than thoſe of which our limits can be ſuppoſed to admit.

ELEMENTS OF MUSIC.

THEORETICAL and PRACTICAL (†).

PRELIMINARY DISCOURSE.

74 Muſic conſidered in a double view.

MUSIC may be conſidered, either as an art, which has for its object one of the greateſt pleaſures of which our ſenſes (‡) are ſuſceptible; or as a ſcience, by which that art is reduced to principles. This is the double view in which we mean to treat of muſic in this work.

75 Progreſs of muſic like that of other arts and ſciences.

It has been the caſe with muſic as with all the other arts invented by men: ſome facts were at firſt diſcovered by accident; ſoon afterwards reflection and obſervation inveſtigated others; and from theſe facts, properly diſpoſed and united, philoſophers were not ſlow in forming a body of ſcience, which afterwards increaſed by degrees.

The firſt theories of muſic were perhaps as ancient as the earlieſt age which we know to have been diſtinguiſhed by philoſophy, even as the age of Pythagoras; nor does hiſtory leave us any room to doubt, that from the period when that philoſopher taught, the ancients cultivated muſic, both as an art and as a ſcience, with great aſſiduity. But there remains to us much uncertainty concerning the degree of perfection to which they brought it. Almoſt every queſtion which has been propoſed with reſpect to the muſic of the ancients has divided the learned; and may probably ſtill continue to divide them, for want of monuments ſufficient in their number, and inconteſtable in their nature, from whence we might be enabled to exhibit teſtimonies and diſcoveries inſtead of ſuppoſitions and conjectures. In the preceding hiſtory we have ſtated a few facts reſpecting the nature of ancient muſic, and the inventors of the ſeveral muſical inſtruments; but it were to be wiſhed, that, in order to elucidate, as much as poſſible, a point ſo momentous in the hiſtory of the ſciences, ſome perſon of learning, equally ſkilled in the Greek language and in muſic, ſhould exert himſelf to unite and diſcuſs in the ſame work the moſt probable opinions eſtabliſhed or propoſed by the learned upon a ſubject ſo difficult and curious. This philoſophical hiſtory of ancient muſic is a work which might highly embelliſh the literature of our times.

76 The hiſtory of muſic a deſideratum in literature.

In the mean time, till an author can be found ſufficiently inſtructed in the arts and in hiſtory to undertake ſuch a labour with ſucceſs, we ſhall content ourſelves with conſidering the preſent ſtate of muſic, and limit our endeavours to the explication of thoſe acceſſions which have accrued to the theory of muſic in theſe latter times.

There are two departments in muſic, melody * and harmony †. Melody is the art of arranging ſeveral ſounds in ſucceſſion one to another in a manner agreeable to the ear; harmony is the art of pleaſing that organ by the union of ſeveral ſounds which are heard at one and the ſame time. Melody has been known and felt through all ages: perhaps the ſame cannot be affirmed of harmony (§); we know not whether the ancients made any uſe of it or not, nor at what period it began to be practiſed.

* See *Melody*
† See *Harmony*.

Not but that the ancients certainly employed in their muſic

(†) To deliver the elementary principles of muſic, theoretical and practical, in a manner which may prove at once entertaining and inſtructve, without protracting this article much beyond the limits preſcribed in our plan, appears to us no eaſy taſk. We therefore heſitated for ſome time, whether to try our own ſtrength, or to follow ſome eminent author on the ſame ſubject. Of theſe the laſt ſeemed preferable. Amongſt theſe authors, none appeared to us to have written any thing ſo fit for our purpoſe as M. D'Alembert, whoſe treatiſe on muſic is the moſt methodical, perſpicuous, conciſe, and elegant diſſertation on that ſubject with which we are acquainted. As it was unknown to moſt Engliſh readers before the former edition of this work, it ought to have all the merit of an original. We have given a faithful tranſlation of it; but in the notes, ſeveral remarks are added, and many authors quoted, which will not be found in the original. It is a work ſo ſyſtematically compoſed, that all attempts to abridge it, without rendering it obſcure and imperfect, would be impracticable. It is perhaps impoſſible to render the ſyſtem of muſic intelligible in a work of leſs compaſs than that with which our readers are now preſented; and, in our judgment, a performance of this kind, which is written in ſuch a manner as not to be generally underſtood, were much better ſuppreſſed.

(‡) In this paſſage, and in the definitions of melody and harmony, our author ſeems to have adopted the vulgar error, that the pleaſures of muſic terminates in corporeal ſenſe. He would have pronounced it abſurd to aſſert the ſame thing of painting. Yet if the former be no more than a mere pleaſure of corporeal ſenſe, the latter muſt likewiſe be ranked in the ſame predicament. We acknowledge that corporeal ſenſe is the vehicle of ſound; but it is plain from our immediate feelings, that the reſults of ſound arranged according to the principles of melody, or combined and diſpoſed according to the laws of harmony, are the objects of a reflex or internal ſenſe.

For a more ſatisfactory diſcuſſion of this matter, the reader may conſult that elegant and judicious treatiſe on Muſical Expreſſion by Mr Aviſon. In the mean time it may be neceſſary to add, that, in order to ſhun the appearance of affectation, we ſhall uſe the ordinary terms by which muſical ſenſations, or the mediums by which they are conveyed, are generally denominated.

(§) Though no certainty can be obtained what the ancients underſtood of harmony, nor in what manner and in what period they practiſed it; yet it is not without probability, that, both in ſpeculation and practice, they

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muſic thoſe chords which were moſt perfect and ſimple; ſuch as the octave, the fifth, and the third; but it ſeems doubtful whether they knew any of the other conſonances or not, or even whether in practice they could deduce the ſame advantages from the ſimple chords which were known to them, that have afterwards accrued from experience and combinations.

If that harmony which we now practice owes its origin to the experience and reflection of the moderns, there is the higheſt probability that the firſt eſſays of this art, as of all the others, were feeble, and the progreſs of its efforts almoſt imperceptible; and that, in the courſe of time, improving by ſmall gradations, the ſucceſſive labours of ſeveral geniuſes have elevated it to that degree of perfection in which at preſent we find it.

77 The origin of arts often accidental, and their progreſs gradual.

The firſt inventor of harmony eſcapes our inveſtigation, from the ſame cauſes which leave us ignorant of thoſe who firſt invented each particular ſcience; becauſe the original inventors could only advance one ſtep, a ſucceeding diſcoverer afterwards made a more ſenſible improvement, and the firſt imperfect eſſays in every kind were loſt in the more extenſive and ſtriking views to which they led. Thus the arts which we now enjoy, are for the moſt part far from being due to any particular man, or to any nation excluſively: they are produced by the united and ſucceſſive endeavours of mankind; they are the reſults of ſuch continued and united reflections, as have been formed by all men at all periods and in all nations.

It might, however, be wiſhed, that after having aſcertained, with as much accuracy as poſſible, the ſtate of ancient muſic by the ſmall number of Greek authors which remain to us, the ſame application were immediately directed to inveſtigate the firſt inconteſtable traces of harmony which appear in the ſucceeding ages, and to purſue thoſe traces from period to period. The products of theſe reſearches would doubtleſs be very imperfect, becauſe the books and monuments of the middle ages are by far too few to enlighten that gloomy and barbarous era; yet theſe diſcoveries would ſtill be precious to a philoſopher, who delights to obſerve the human mind in the gradual evolutions of its powers, and the progreſs of its attainments.

78 Delineations of the laws of harmony recent and imperfect.

The firſt compoſitions upon the laws of harmony which we know, are of no higher antiquity than two ages prior to our own; and they were followed by many others. But none of theſe eſſays was capable of ſatisfying the mind concerning the principles of harmony: they confined themſelves almoſt entirely to the ſingle occupation of collecting rules, without endeavouring to account for them; neither had their analogies one with another, nor their common ſource, been perceived; a blind and unenlightened experience was the only compaſs by which the artiſt could direct and regulate his courſe.

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M. Rameau was the firſt who began to transfuſe light and order through this chaos. In the different tones produced by the ſame ſonorous body, he found the moſt probable origin of harmony, and the cauſe of that pleaſure which we receive from it. His principle he unfolded, and ſhowed how the different phenomena of muſic were produced by it: he reduced all the conſonances to a ſmall number of ſimple and fundamental chords, of which the others are only combinations or various arrangements. He has, in ſhort, been able to diſcover, and render ſenſible to others, the mutual dependence between melody and harmony.

79 Its precepts not deduced from any principle till by M. Rameau.

80 The author's motives for writing theſe elements.

Though theſe different topics may be contained in the writings of this celebrated artiſt, and in theſe writings may be underſtood by philoſophers who are likewiſe adepts in the art of muſic; ſtill, however, ſuch muſicians as were not philoſophers, and ſuch philoſophers as were not muſicians, have long deſired to ſee theſe objects brought more within the reach of their capacity: ſuch is the intention of the treatiſe I now preſent to the public. I had formerly compoſed it for the uſe of ſome friends. As the work appeared to them clear and methodical, they have engaged me to publiſh it, perſuaded (though perhaps with too much credulity) that it might be uſeful to facilitate the progreſs of initiates in the ſtudy of harmony.

This was the only motive which could have determined me to publiſh a book of which I might without heſitation aſſume the honour, if its materials had been the fruits of my own invention, but in which I can now boaſt no other merit than that of having developed, elucidated, and perhaps in ſome reſpects improved, the ideas of another (c).

81 Improvements of this edition.

The firſt edition of this eſſay, publiſhed 1752, having been favourably received by the world, and copies no longer to be found in the hands of bookſellers, I have endeavoured to render this more perfect. The detail which I mean to give of my labour, will preſent the reader with a general idea of the principle of M. Rameau, of the conſequences deduced from it, of the manner in which I have diſpoſed this principle and its conſequences; in ſhort, of what is ſtill a-wanting, and might be advantageous to the theory of this amiable art; of what ſtill remains for the learned to contribute towards the perfection of this theory; of the rocks and quickſands which they ought to avoid in this reſearch, and which could ſerve no other purpoſe than to retard their progreſs.

82 Account of the work in general.

83 Rameau's origin of harmony.

Every ſonorous body, beſides its principal ſound, likewiſe exhibits to the ear the 12th and 17th major of that ſound. This multiplicity of different yet concordant ſounds, known for a conſiderable time, conſtitutes

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they were in poſſeſſion of what we denominate *counterpoint*. Without ſuppoſing this, there are ſome paſſages in the Greek authors which can admit of no ſatisfactory interpretation. See the *Origin and Progreſs of Language*, Vol. II. Beſides, we can diſcover ſome veſtiges of harmony, however rude and imperfect, in the hiſtory of the Gothic ages, and amongſt the moſt barbarous people. This they could not have derived from more cultivated countries, becauſe it appears to be incorporated with their national muſic. The moſt rational account, therefore, which can be given, ſeems to be, that it was conveyed in a mechanical or traditionary manner through the Roman provinces from a more remote period of antiquity.

(c) See M. Rameau's letter upon this ſubject, *Merc. de Mai* 1752.

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tutes the baſis of the whole theory of M. Rameau, and the foundation upon which he builds the whole ſuperſtructure of a muſical ſyſtem *. In theſe our *elements* may be ſeen, how from this experiment one may deduce, by an eaſy operation of reaſon, the chief points of melody and harmony; the perfect † chord, as well major as minor; the two ‡ tetrachords employed in ancient muſic; the formation of our diatonic ‖ ſcale; the different values § which the ſame ſound may have in that ſcale, according to the turn which is given to the baſs *; the alterations ¶ which we obſerve in that ſcale, and the reaſon why they are totally imperceptible to the ear; the rules peculiar to the mode † major; the difficulty in ‡ intonation of forming three tones ‖ in ſucceſſion; the reaſon why two perfect chords are proſcribed in immediate ſucceſſion in the diatonic order; the origin of the minor mode, its ſubordination to the mode major, and its variations; the uſe of diſcord §; the cauſes of ſuch effects as are produced by different kinds of muſic, whether diatonic, chromatic *, or enharmonic †; the principles and laws of temperament ‡. In this diſcourſe we can only point out thoſe different objects, the ſubſequent eſſay being deſigned to explain them with the minuteneſs and preciſion which they require.

* See *Syſtem.*

† See *Chord.*
‡ See *Tetrachord.*
‖ See *Diatonic.*
§ See *Value.*
* See *Baſs.*
¶ See *Alteration.*
† See *Mode.*
‡ See *Intonation.*
‖ See *Tone.*

§ See *Diſcord.*
* See *Chromatic.*
† See *Enharmonic.*
‡ See *Temperament.*

One end which we have propoſed in this treatiſe, was not only to place the diſcoveries of M. Rameau in their moſt conſpicuous and advantageous light, but even in particular reſpects to render them more ſimple. —For inſtance, beſides the fundamental experiment which we have mentioned above, that celebrated muſician, to render the explication of ſome particular phenomena in muſic more acceſſible, had recourſe to another experiment; I mean that which ſhows that a ſonorous body ſtruck and put in vibration, forces its 12th and 17th major in deſcending to divide themſelves and produce a tremulous ſound. The chief uſe which M. Rameau made of this ſecond experiment was to inveſtigate the origin of the minor mode, and to give a ſatisfactory account of ſome other rules eſtabliſhed in harmony; and with reſpect to this in our firſt edition we have implicitly followed him: in this we have found means to deduce from the firſt experiment alone the formation of the minor mode, and beſides to diſengage that formation from all the queſtions which were foreign to it.

It is the ſame caſe with ſome other points (as the origin of the chord of the ſub-dominant §, and the explication of the ſeventh in ſome peculiar reſpects), upon which it is imagined that we have ſimplified, and perhaps in ſome meaſure extended, the principles of the celebrated artiſt.

§ See *Sub-dominant.*

We have likewiſe baniſhed from this edition, as from the former, every conſideration of geometrical, arithmetical, and harmonical proportions and progreſſions, which authors have endeavoured to find in the mixture and protraction of tones produced by a ſonorous body; perſuaded as we are, that M. Rameau was under no neceſſity of paying the leaſt regard to theſe proportions, which we believe to be not only uſeleſs, but even, if we may venture to ſay ſo, fallacious when applied to the theory of muſic. In ſhort, though the relations produced by the octave, the fifth, and the third, &c. were quite different from what they are; though in theſe chords we ſhould neither remark any progreſſion nor any law; though they ſhould be incommenſurable one with another; the protracted tone of a ſonorous body, and the multiplied ſounds which reſult from it, are a ſufficient foundation for the whole harmonic ſyſtem.

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84 Theoretical muſicians cautioned with regard to the admiſſion of mathematical or metaphyſical principles in muſic.

But though this work is intended to explain the theory of muſic, and to reduce it to a ſyſtem more complete and more luminous than has hitherto been done, we ought to caution thoſe who ſhall read this treatiſe, that they may be careful not to deceive themſelves, either by miſapprehending the nature of our object, or the end which our endeavours purſue.

We muſt not here look for that ſtriking evidence which is peculiar to geometrical diſcoveries alone, and which can be ſo rarely obtained in theſe mixed diſquiſitions, where natural philoſophy is likewiſe concerned: into the theory of muſical phenomena there muſt always enter a particular kind of metaphyſics, which theſe phenomena implicitly take for granted, and which brings along with it its natural obſcurity. In this ſubject, therefore, it would be abſurd to expect what is called *demonſtration*: it is an atchievement of no ſmall importance, to have reduced the principal facts to a ſyſtem conſiſtent with itſelf, and firmly connected in its parts; to have deduced them from one ſimple experiment; and to have eſtabliſhed upon this foundation the moſt common and eſſential rules of the muſical art. But in another view, if here it be improper to require that intimate and unalterable conviction which can only be produced by the ſtrongeſt evidence, we remain in the mean time doubtful whether it is poſſible to elucidate this ſubject more ſtrongly.

After this declaration, one ſhould not be aſtoniſhed, that, amongſt the facts which are deduced from our fundamental experiment, there ſhould be ſome which appear immediately to depend upon that experiment, and others which are deduced from it in a way more remote and leſs direct. In diſquiſitions of natural philoſophy, where we are ſcarcely allowed to uſe any other arguments, except ſuch as ariſe from analogy or congruity, it is natural that the analogy ſhould be ſometimes more ſometimes leſs ſenſible: and we will venture to aſſert, that ſuch a mind muſt be very improper for philoſophy, which cannot recogniſe and diſtinguiſh this gradation and the different circumſtances on which it proceeds. It is not even ſurpriſing, that in a ſubject where analogy alone can take place, this conductreſs ſhould deſert us all at once in our attempts to account for certain phenomena. This likewiſe happens in the ſubject which we now treat; nor do we conceal the fact, however mortifying, that there are certain points (though their number be but ſmall) which appear ſtill in ſome degree unaccountable from our principle. Such, for inſtance, is the procedure of the diatonic ſcale in deſcending; the formation of the chord commonly termed the *ſixth redundant* * or *ſuperfluous*, and ſome other facts of leſs importance, for which as yet we can ſcarcely offer any ſatisfactory account except from experience alone.

* See *Redundant.*

Thus, though the greateſt number of the phenomena in the art of muſic appear to be deducible in a ſimple and eaſy manner from the protracted tone of ſonorous bodies, one ought not perhaps with too much temerity to affirm as yet, that this mixed and protracted tone is *demonſtratively* the only original principle

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of harmony (D). But in the mean time it would not be leſs unjuſt to reject this principle, becauſe certain phenomena appear to be deduced from it with leſs ſucceſs than others. It is only neceſſary to conclude from this, either that by future ſcrutinies means may be found for reducing theſe phenomena to this principle; or that harmony has perhaps ſome other unknown principle, more general than that which reſults from the protracted and compounded tone of ſonorous bodies, and of which this is only a branch; or, laſtly, that we ought not perhaps to attempt the reduction of the whole ſcience of muſic to one and the ſame principle; which, however, is the natural effect of an impatience ſo frequent even among philoſophers themſelves, which induces them to take a part for the whole, and to judge of objects in their full extent by the greateſt number of their appearances.

85 Rameau's primary experiment has not as yet accounted for all the phenomena of muſic. Perhaps ſome other may be neceſſary.

In thoſe ſciences which are called *phyſico-mathematical* (and amongſt this number perhaps the ſcience of ſounds may be placed), there are ſome phenomena which depend only upon one ſingle principle and one ſingle experiment: there are others which neceſſarily ſuppoſe a greater number both of experiments and principles, whoſe combination is indiſpenſable in forming an exact and complete ſyſtem; and muſic perhaps is in this laſt caſe. It is for this reaſon, that, whilſt we beſtow on M. Rameau all due praiſe, we ſhould not at the ſame time neglect to ſtimulate the learned in their endeavours to carry them ſtill to higher degrees of perfection, by adding, if it is poſſible, ſuch improvements as may be wanting to conſummate the ſcience.

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Whatever the reſult of their efforts may be, the reputation of this intelligent artiſt has nothing to fear: he will ſtill have the advantage of being the firſt who rendered muſic a ſcience worthy of philoſophical attention; to have made its practice more ſimple and eaſy; and to have taught muſicians to employ in this ſubject the light of reaſon and analogy.

We would the more willingly perſuade thoſe who are ſkilled in theory and eminent in practice to extend and improve the views of him who before them purſued and pointed out the career, becauſe many amongſt them have already made laudable attempts, and have even been in ſome meaſure ſucceſsful in diffuſing new light through the theory of this enchanting art. It was with this view that the celebrated Tartini has preſented us in 1754 with a treatiſe of harmony, founded on a principle different from that of M. Rameau. This principle is the reſult of a moſt beautiful experiment (†).

86 Tartini's experiment.

If at once two different ſounds are produced from two inſtruments of the ſame kind, theſe two ſounds

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(D) The *demonſtration* of the principles of harmony by M. Rameau was not thus intitled in the expoſition which he preſented in the year 1749 to the Academy of Sciences, and which that Society beſides approved with all the eulogiums which the author deſerved; the title, as inſerted in the regiſter of the academy, was, "A memorial, in which are explained the foundations of a ſyſtem of muſic theoretical and practical." It is likewiſe under this title that it was announced and approved of by the Commiſſioners, who in their printed report, which the public may read along with M. Rameau's memorial, have never dignified his theory with any other name than that of a *ſyſtem*, the only name in reality which is expreſſive of its nature. M. Rameau, who, after the approbation of the Academy, has thought himſelf at liberty to adorn his ſyſtem with the name of a *demonſtration*, did not certainly recollect what the Academy has frequently declared; that, in approving any work, it was by no means implied, that the principles of that work appeared to them demonſtrated. In ſhort, M. Rameau himſelf, in ſome writings poſterior to what he calls his *demonſtration*, acknowledges, that upon particular points in the theory of the muſical art, he is under a neceſſity of having recourſe to analogy and aptitude; this excludes every idea of demonſtration, and reſtores the theory of the muſical art exhibited by M. Rameau to the claſs in which it can only be ranked with propriety, I mean the claſs of probabilities.

(†) Had the utility of the preliminary diſcourſe in which we are now engaged been leſs important and obvious than it really is, we ſhould not have given ourſelves the trouble of tranſlating, nor our readers that of peruſing it. But it muſt be evident to every one, that the cautions here given, and the advices offered, are no leſs applicable to ſtudents than to authors. The firſt queſtion here decided is, Whether pure mathematics can be ſucceſsfully applied to the theory of muſic? The author is juſtly of a contrary opinion. It may certainly be doubted with great juſtice, whether the ſolid contents of ſonorous bodies, and their degrees of cohesion or elaſticity, can be aſcertained with ſufficient accuracy to render them the ſubjects of muſical ſpeculation, and to determine their effects with ſuch preciſion as may render the concluſions deduced from them geometrically true. It is admitted, that ſound is a ſecondary quality of matter, and that ſecondary qualities have no obvious connection which we can trace with the ſenſations produced by them. Experience, therefore, and not ſpeculation, is the grand criterion of muſical phenomena. For the effects of geometry in illuſtrating the theory of muſic (if any will ſtill be ſo credulous as to pay them much attention), the Engliſh reader may conſult Smith's Harmonics, Malcom's Diſſertation on Muſic, and Pleydel's Treatiſe on the ſame ſubject inſerted in a former edition of this work. Our author next treats of the famous diſcovery made by Sig. Tartini, of which the reader may accept the following compendious account.

If two ſounds be produced at the ſame time properly tuned and with due force, from their conjunction a third ſound is generated, ſo much more diſtinctly to be perceived by delicate ears as the relation between the generating ſounds is more ſimple; yet from this rule we muſt except the uniſon and octave. From the fifth is produced a ſound uniſon with its loweſt generator; from the fourth, one which is an octave lower than the higheſt of its generators; from the third major, one which is an octave lower than its loweſt; and from the

ſixth

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ſounds generate * a third different from both the others. They have inſerted in the *Encyclopédie*, under the article *Fundamental*, a detail of this experiment according to M. Tartini; and we owe to the public an information of which in compoſing this article we were ignorant: M. Rameau, a member of the Royal Society at Montpellier, had preſented to that ſociety in the year 1753, before the work of M. Tartini had appeared, a memorial printed the ſame year, and where may be found the ſame experiment diſplayed at full length. In relating this fact, which it was neceſſary for us to do, it is by no means our intention to detract in any degree from the reputation of M. Tartini; we are perſuaded that he owes this diſcovery to his own reſearches alone: but we think ourſelves obliged in honour to give public teſtimony in favour of him who was the firſt in exhibiting this diſcovery.

* See *Generate.*

87 Its diſcovery originally due to Rameau.

But whatever be the caſe, it is in this experiment that M. Tartini attempts to find the origin of harmony: his book, however, is written in a manner ſo obſcure, that it is impoſſible for us to form any judgement of it; and we are told that others diſtinguiſhed for their knowledge of the ſcience are of the ſame opinion. It were to be wiſhed that the author would engage ſome man of letters, equally practiſed in muſic and ſkilled in the art of writing, to unfold theſe ideas which he has not diſcovered with ſufficient perſpicuity, and from whence the art might perhaps derive conſiderable advantage if they were placed in a proper light. Of this I am ſo much the more perſuaded, that even though this experiment ſhould not be regarded by others in the ſame view with M. Tartini as the foundation of the muſical art, it is nevertheleſs extremely probable that one might uſe it with the greateſt advantage to enlighten and facilitate the practice of harmony.

In exhorting philoſophers and artiſts to make new attempts for the advancement of the theory of muſic, we ought at the ſame time to let them know the danger of miſtaking what is the real end of their reſearches. Experience is the only foundation upon which they can proceed; it is alone by the obſervation of facts, by bringing them together in one view, by ſhowing their dependency upon one, if poſſible, or at leaſt upon a very ſmall number of primary facts, that they can reach the end to which they ſo ardently aſpire, the important end of eſtabliſhing an exact theory of muſic, where nothing is wanting, nothing obſcure, but every thing diſcovered in its full extent, and in its proper light. The philoſopher who is properly enlightened, will not give himſelf the trouble to explain ſuch facts as are leſs eſſential to his art, becauſe he can diſcern thoſe on which he ought to expatiate for its proper illuſtration. If one would eſtimate them according to their proper value, he will only find it neceſſary to caſt his eyes upon the attempts of natural philoſophers who have diſcovered the greateſt ſkill in their ſcience; to explain, for inſtance, the multiplicity of tones produced by ſonorous bodies. Theſe ſages, after having remarked (what is by no means difficult to conclude) that the univerſal vibration of a muſical ſtring is a mixture of ſeveral partial vibrations, from thence infer, that a ſonorous body ought to produce a multiplicity of tones, as it really does. But why ſhould this multiplied ſound only appear to contain three, and why theſe three preferable to others? Some pretend that there are particles in the air, which, by their different degrees of magnitude and texture, being naturally ſuſceptible of different oſcillations, produce the multiplicity of ſound in queſtion. But what do we know of all this hypothetical doctrine? And though it ſhould even be granted, that there is ſuch a diverſity of tenſion in theſe aerial particles, how ſhould this diverſity prevent them from being all of them confounded in their vibrations by the motions of a ſonorous body? What then ſhould be the reſult, when the vibrations arrive at our ears, but a confuſed and inappretiable† noiſe, where one could not diſtinguiſh any particular ſound?

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88 Mechanical concluſions inadequate to the ſituation of muſical phenomena.

† See *Inappretiable.*

89 Metaphyſical concluſions leſs adequate.

If philoſophical muſicians ought not to loſe their time in ſearching for mechanical explications of the phenomena in muſic, explications which will always be found vague and unſatisfactory; much leſs is it their province to exhauſt their powers in vain attempts to riſe above their ſphere into a region ſtill more remote from the proſpect of their faculties, and to loſe themſelves in a labyrinth of metaphyſical ſpeculations upon the cauſes of that pleaſure which we feel from harmony. In vain would they accumulate hypotheſis on hypotheſis, to find a reaſon why ſome chords ſhould pleaſe us

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fixth minor (whoſe higheſt note forms an octave with the loweſt in the third formerly mentioned) will be produced a ſound lower by a double octave than the higheſt of the leſſer fixth; from the third minor, one which is double the diſtance of a greater third from its loweſt; but from the fixth major (whoſe higheſt note makes an octave to the loweſt in the third minor) will be produced a ſound only lower by double the quantity of a greater third than the higheſt; from the ſecond major, a ſound lower by a double octave than the loweſt; from a ſecond minor, a ſound lower by triple the quantity of a third major than the higheſt; from the interval of a diatonic or greater ſemitone, a ſound lower by a triple octave than the higheſt; from that of a minor or chromatic ſemitone, a ſound lower by the quantity of a fifth four times multiplied than the loweſt, &c. &c. But that theſe muſical phenomena may be tried by experiments proper to aſcertain them, two hautboys tuned with ſcrupulous exactneſs muſt be procured, whilſt the muſicians are placed at the diſtance of ſome paces one from the other, and the hearers in the middle. The violin will likewiſe give the ſame chords, but they will be leſs diſtinctly perceived, and the experiment more fallacious, becauſe the vibrations of other ſtrings may be ſuppoſed to enter into it.

If our Engliſh reader ſhould be curious to examine theſe experiments and the deductions made from them in the theory of muſic, he will find them clearly explained and illuſtrated in a treatiſe called *Principles and Power of Harmony*, printed at London in the year 1771.

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us more than others. The futility of theſe ſuppoſitious accounts muſt be obvious to every one who has the leaſt penetration. Let us judge of the reſt by the moſt probable which has till now been invented for that purpoſe. Some aſcribe the different degrees of pleaſure which we feel from chords, to the more or leſs frequent coincidence of vibrations; others to the relations which theſe vibrations have among themſelves as they are more or leſs ſimple. But why ſhould this coincidence of vibrations, that is to ſay, their ſimultaneous impulſe on the ſame organs of ſenſation, and the accident of beginning frequently at the ſame time, prove ſo great a ſource of pleaſure? Upon what is this gratuitous ſuppoſition founded? And though one ſhould grant it, would it not follow from thence, that the ſame chord ſhould ſucceſſively and rapidly affect us with contrary ſenſations, ſince the vibrations are alternately coincident and diſcrepant? On the other hand, how ſhould the ear be ſo ſenſible to the ſimplicity of relations, whilſt for the moſt part theſe relations are entirely unknown to him whoſe organs are notwithſtanding ſenſibly affected with the charms of agreeable muſic? We may conceive without difficulty how the eye judges of relations; but how does the ear form ſimilar judgments? Beſides, why ſhould certain chords which are extremely pleaſing in themſelves, ſuch as the fifth, loſe almoſt nothing of the pleaſure which they give us, when they are altered, and of conſequence when the ſimplicity of their relations are deſtroyed; whilſt other chords, which are likewiſe extremely agreeable, ſuch as the third, become harſh almoſt by the ſmalleſt alteration; nay, whilſt the moſt perfect and the moſt agreeable of all chords, I mean the octave, cannot ſuffer the moſt inconſiderable change? Let us in ſincerity confeſs our ignorance concerning the genuine cauſes of theſe effects (†). The metaphyſical conjectures concerning the accouſtic organs are probably in the ſame predicament with thoſe which are formed concerning the organs of viſion, if one may ſpeak ſo, in which philoſophers have even till now made ſuch inconſiderable progreſs, and in all likelihood will not be ſurpaſſed by their ſucceſſors.

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Since the theory of muſic, even to thoſe who confine themſelves within its limits, implies queſtions from which every wiſe muſician will abſtain, with much greater reaſon ſhould they avoid idle excurſions beyond the boundaries of that theory, and endeavours to inveſtigate between muſic and the other ſciences chimerical relations which have no foundation in nature. The ſingular opinions advanced upon this ſubject by ſome even of the moſt celebrated muſicians, deſerve not to be reſcued from oblivion, nor refuted; and ought only to be regarded as a new proof how far men of genius may deviate from truth and taſte, when they engage in ſubjects of which they are ignorant.

The rules which we have attempted to eſtabliſh concerning the track which every one ought to purſue in the theory of the muſical art, may ſuffice to ſhow our readers the end which we have propoſed, and which we have endeavoured to attain in this Work. We have nothing to do here (for it is proper that we repeat it), we have nothing to do with the mechanical principles of protracted and harmonic tones produced by ſonorous bodies; principles which till now have been explored in vain, and which perhaps may be long explored with the ſame ſucceſs; we have ſtill

(†) We have as great an averſion as our author to the explication of muſical phenomena from mechanical principles; yet we fear the following obſervations, deduced from irreſiſtible and univerſal experience, evidently ſhow that the latter neceſſarily depend on the former. It is, for inſtance, univerſally allowed, that diſſonances grate and concords pleaſe a muſical ear: It is likewiſe no leſs unanimouſly agreed, that in proportion as a chord is perfect, the pleaſure is increaſed; now the perfection of a chord conſiſts in the regularity and frequency of coincident oſcillations between two ſonorous bodies impelled to vibrate: thus the third is a chord leſs perfect than the fifth, and the fifth than the octave. Of all theſe conſonances, therefore, the octave is moſt pleaſing to the ear; the fifth next, and the third laſt. In abſolute diſcords, the vibrations are never coincident, and of conſequence a perpetual pulſation or jarring is recogniſed between the protracted ſounds, which exceedingly hurts the ear; but in proportion as the vibrations coincide, thoſe pulſations are ſuperſeded, and a kindred formed betwixt the two continued ſounds, which delights even the corporeal ſenſe: that relation, therefore, without recogniſing the aptitudes which produce it, muſt be the obvious cauſe of the pleaſure which chords give to the ear. What we mean by coincident vibrations is, that while one ſonorous body performs a given number of vibrations, another performs a different number in the ſame time; ſo that the vibrations of the quickeſt muſt ſometimes be ſimultaneous with thoſe of the ſloweſt, as will plainly appear from the following deduction: Between the extremes of a third, the vibrations of the higheſt are as 5 to 4 of the loweſt; thoſe of the fifth as 3 to 2; thoſe of the octave as 2 to 1. Thus it is obvious, that in proportion to the frequent coincidence of periodical vibrations, the compound ſenſation is more agreeable to the ear. Now, to inquire why that organ ſhould be rather pleaſed with theſe than with the pulſation and tremulous motion of encountering vibrations which can never coaleſce, would be to aſk why the touch is rather pleaſed with poliſhed than rough ſurfaces? or, why the eye is rather pleaſed with the waving line of Hogarth than with ſharp angles and abrupt or irregular prominences? No alteration of which any chord is ſuſceptible will hurt the ear unleſs it ſhould violate or deſtroy the regular and periodical coincidence of vibrations. When alterations can be made without this diſagreeable effect, they form a pleaſing diverſity; but ſtill this fact corroborates our argument, that in proportion as any chord is perfect, it is impatient of the ſmalleſt alteration; for this reaſon, even in temperament, the octave endures no alteration at all, and the fifth as little as poſſible.

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leſs to do with the metaphyſical cauſes of thoſe pleaſing ſenſations which are impreſſed on the mind by harmony; cauſes which are ſtill leſs diſcovered, and which, according to all appearances, will remain latent in perpetual obſcurity. We are alone concerned to ſhow how the chief and moſt eſſential laws of harmony may be deduced from one ſingle experiment; and for which, if we may ſpeak ſo, preceding artiſts have been under a neceſſity of groping in the dark.

With an intention to render this work as generally uſeful as poſſible, I have endeavoured to adapt it to the capacity even of thoſe who are abſolutely uninſtructed in muſic. To accompliſh this deſign, it appeared neceſſary to purſue the following plan.

90 Plan of the treatiſe.

To begin with a ſhort introduction, in which are defined the technical terms moſt frequently uſed in this art; ſuch as *chord*, *harmony*, *key*, *third*, *fifth*, *octave*, &c.

Afterwards to enter into the theory of harmony, which is explained according to M. Rameau, with all poſſible perſpicuity. This is the ſubject of the *Firſt Part;* which, as well as the introduction, preſuppoſes no other knowledge of muſic than that of the names and powers of the ſyllables, *ut*, *re*, *mi*, *fa*, *ſol*, *la*, *ſi*, or C, D, E, F, G, A, B, which all the world knows (†).

The theory of harmony requires ſome arithmetical calculations, which are neceſſary for comparing ſounds one with another. Theſe calculations are very ſhort, extremely ſimple, and conducted in ſuch a manner as to be ſenſibly comprehended by every one; they demand no operation but what is clearly explained, and which every ſchool-boy with the ſlighteſt attention may perform. Yet, that even the trouble of this may be ſpared to ſuch as are not diſpoſed to take it, I have not inſerted theſe calculations in the body of the treatiſe, but transferred them to the notes, which the reader may omit, if he can ſatisfy himſelf by taking for granted the propoſitions contained in the work, which will be found proved in the notes.

Theſe calculations I have not endeavoured to multiply; I could even have wiſhed to ſuppreſs them, if it had been poſſible: ſo much did it appear to me to be apprehended that my readers might be miſled upon this ſubject, and might either believe themſelves, or at leaſt ſuſpect me of believing, all this arithmetic neceſſary to form an artiſt. Calculations may indeed facilitate the underſtanding of certain points in the theory, as of the relations between the different notes in the gammut and of the temperament; but the calculations neceſſary for treating of theſe points are ſo ſimple, and, to ſpeak more properly, of ſo little importance, that nothing can require a leſs minute or oſtentatious diſplay. Do not let us imitate thoſe muſicians who, believing themſelves geometers, or thoſe geometers who, believing themſelves muſicians, fill their writings with figures upon figures; imagining, perhaps, that this apparatus is neceſſary to the art. The propenſity of adorning their works with a falſe air of ſcience, can only impoſe upon credulity and ignorance, and ſerve no other purpoſe but to render their treatiſes more obſcure and leſs inſtructive. In the character of a geometer, I think I have ſome right to proteſt here (if I may be permitted to expreſs myſelf in this manner) againſt ſuch ridiculous abuſe of geometry in muſic.

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91 Mathematical concluſions not tranſferable to ſenſible objects without caution.

This I may do with ſo much more reaſon, that in this ſubject the foundations of thoſe calculations are in ſome manner hypothetical, and can never ariſe to a degree of certainty above hypotheſis. The relation of the octave as 1 to 2, that of the fifth as 2 to 3, that of the third major as 4 to 5, &c are not perhaps the genuine relations eſtabliſhed in nature; but only relations which approach them, and ſuch as experience can diſcover. For are the reſults of experience any thing more but mere approaches to truth?

But happily theſe approximated relations are ſufficient, though they ſhould not be exactly agreeable to truth, for giving a ſatisfactory account of thoſe phenomena which depend on the relations of ſound; as in the difference between the notes in the gammut, of the alterations neceſſary in the fifth and third, of the different manner in which inſtruments are tuned, and other facts of the ſame kind. If the relations of the octave, of the fifth, and of the third, are not exactly ſuch as we have ſuppoſed them, at leaſt no experiments can prove that they are not ſo; and ſince theſe relations are ſignified by a ſimple expreſſion, ſince they are beſides ſufficient for all the purpoſes of theory, it would not only be uſeleſs, but even contrary to ſound philoſophy, ſhould any one incline to invent other relations, to form the baſis of any ſyſtem of muſic leſs eaſy and ſimple than that which we have delineated in this treatiſe.

The *ſecond part* contains the moſt eſſential rules of compoſition *, or in other words the practice of harmony. Theſe rules are founded on the principles laid down in the *firſt part;* yet thoſe who wiſh to underſtand no more than is neceſſary for practice, without exploring the reaſons why ſuch practical rules are neceſſary, may limit the objects of their ſtudy to the *introduction* and the *ſecond part*. They who have read the *firſt part*, will find at every rule contained in the *ſecond*, a reference to that paſſage in the

* See *Compoſition.*

(†) The names of the ſeven notes uſed by the French are here retained, and will indeed be continued through the whole enſuing work; as we imagine, that, if properly aſſociated with the ſounds which they denominate, they will tend to impreſs theſe ſounds more diſtinctly on the memory of the ſcholar than the letters C, D, E, F, G, A, B, from which characters, except in ſol-fa'ing, the notes in the diatonic ſeries are generally named in Britain. Amongſt us, in the progreſs of intonation, the ſyllables *ut*, *re*, and *ſi*, have been omitted, by which means the teachers of church-muſic have rendered it ſtill more difficult to expreſs by the four remaining denominations the various changes of the ſemitones in the octave. As theſe artificially change their places, the ſeven ſyllables above mentioned alſo diverſify their powers, and are variouſly arranged according to the intervals in which the notes they are intended to ſignify may be placed.

For an account of theſe variations, ſee Rouſſeau's Muſical Dictionary, article GAMME. See alſo the Eſſay towards a Rational Syſtem of Muſic, by John Holden, part i. chap. 1.

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the *firſt* where the reaſons for eſtabliſhing that rule are given.

92 Some rules, on account of their intricacy, tranſferred to the notes.

That we may not preſent at once too great a number of objects and precepts, I have tranſferred to the notes in the ſecond part ſeveral rules and obſervations which are leſs frequently put in practice, which perhaps it may be proper to omit till the treatiſe is read a ſecond time, when the reader is well acquainted with the eſſential and fundamental rules explained in it.

This ſecond part, ſtrictly ſpeaking, preſuppoſes, no more than the firſt, any habit of ſinging, nor even any knowledge of muſic; it only requires that one ſhould know, not even the rules and manner of intonation, but merely the poſition of the notes in the cleff *fa* or F on the fourth line, and that of *ſol* or G upon the ſecond: and even this knowledge may be acquired from the work itſelf; for in the beginning of the ſecond part I explain the poſitions of the cleffs and of the notes. Nothing elſe is neceſſary but to render it a little familiar to our memory, and we ſhall have no more difficulty in it.

93 All the rules of compoſition not to be expected in an elementary eſſay.

It would be wrong to expect here all the rules of compoſition, and eſpecially thoſe which direct the compoſition of muſic in ſeveral parts, and which, being leſs ſevere and indiſpenſable, may be chiefly acquired by practice, by ſtudying the moſt approved models, by the aſſiſtance of a proper maſter, but above all by the cultivation of the ear and of the taſte. This treatiſe is properly nothing elſe, if I may be allowed the expreſſion, but the rudiments of muſic, intended for explaining to beginners the fundamental principles, not the practical detail of compoſition. Thoſe who wiſh to enter more deeply into this detail, will either find it in Mr Rameau's treatiſe of harmony, or in the code of muſic which he publiſhed more lately (I), or laſtly in the explication of the theory and practice of muſic by M. Bethizi (K): this laſt book appears to me clear and methodical.

One may look upon it (with reſpect to a practical detail) as a ſupplement to my own performance. I do this juſtice to the author with ſo much more cheerfulneſs, as he is entirely unknown to me, and as his animadverſions upon my work appear to me leſs ſevere than it deſerved (L).

94 Nature the eſſential miſtreſs of muſical compoſition.

Is it neceſſary to add, that, in order to compoſe muſic in a proper taſte, it is by no means enough to have familiarized with much application the principles explained in this treatiſe? Here can only be learned the mechaniſm of the art; it is the province of nature alone to accompliſh the reſt. Without her aſſiſtance, it is no more poſſible to compoſe agreeable muſic by having read theſe elements, than to write verſes in a proper manner with the Dictionary of Richelet. In one word, it is the elements of muſic alone, and not the principles of genius, that the reader may expect to find in this treatiſe.

Such was the aim I purſued in its compoſition, and ſuch ſhould be the ideas of the reader in its peruſal. Once more let me add, that to the diſcovery of its fundamental principles I have not the remoteſt claim. The ſole end which I propoſed was to be uſeful; to reach that end, I have omitted nothing which appeared neceſſary, and I ſhould be ſorry to find my endeavours unſucceſsful. Definitions.

DEFINITIONS OF SEVERAL TECHNICAL TERMS.

I. *What is meant by Melody, by Chord, by Harmony, by Interval.*

95 Melody, what.

1. Melody is nothing elſe but a ſeries of ſounds which ſucceed one to another in a manner agreeable to the ear.

96 Chord and harmony, what.

2. That is called a *chord* which ariſes from the mixture of ſeveral ſounds heard at the ſame time; and harmony is properly a ſeries of chords which in their ſucceſſion one to another delights the ear. A ſingle chord is likewiſe ſometimes called *harmony*, to ſignify the coaleſcence of ſounds which that chord creates, and the ſenſation produced in the ear by that coaleſcence. We ſhall occaſionally uſe the word *harmony* in this laſt ſenſe, but in ſuch a manner as never to leave our meaning ambiguous.

3. In melody and harmony, the diſtance between one ſound and another is called an *interval*; and this is increaſed or diminiſhed as the ſounds between which it intervenes are higher or lower one than the other. See *Interval.*

4. That we may learn to diſtinguiſh the intervals, and the manner of perceiving them, let us take the ordinary ſcale *ut, re, mi, fa, ſol, la, ſi, UT*, C, D, E, F, G, A, B, C, which every perſon whoſe ear or voice is not extremely falſe naturally modulates. Theſe are the obſervations which will occur to us in ſinging this gammut.

97 Account of the ſimple intervals.

The ſound *re* is higher or ſharper than the ſound *ut*, the ſound *mi* higher than the ſound *re*, the ſound *fa* higher than the ſound *mi*, &c. and ſo through the whole octave; ſo that the interval or the diſtance from the ſound *ut* to the ſound *re*, is leſs than the interval or diſtance between the ſound *ut* and the ſound *mi*, the interval from *ut* to *mi* is leſs than that between *ut* and *fa*, &c. and in ſhort that the interval from the firſt to the ſecond *ut* is the greateſt of all.—To diſtinguiſh the firſt from the ſecond *ut*, I have marked the laſt with capital letters.

98 The diſtinction between ſtrong and faint, or acute and grave.

5. In general, the interval between two ſounds is proportionably greater, as one of theſe ſounds is higher or lower with relation to the other: but it is neceſſary to obſerve, that two ſounds may be equally high or low, though unequal in their force. The ſtring of a violin touched with a bow produces always a ſound equally high, whether ſtrongly or faintly ſtruck; the ſound will only have a greater or leſſer degree of ſtrength. It is the ſame with vocal modu-

(I) From my general recommendation of this code, I except the reflections on the principles of ſound which are at the end, and which I ſhould not adviſe any one to read.

(K) Printed at Paris by Lambert in the year 1754.

(L) That criticiſm and my anſwers may be ſeen in the *Journeaux Economiques* of 1752.

Definitions. lation; let any one form a ſound by gradually impelling or ſwelling the voice, the ſound may be perceived to increaſe in its energy, whilſt it continues always equally low or equally high.

99 Between tonic and ſemitonic intervals. 6. We muſt likewiſe obſerve concerning the ſcale, that the intervals between *ut* and *re*, between *re* and *mi*, between *fa* and *ſol*, between *ſol* and *la*, between *la* and *ſi*, are equal, or at leaſt nearly equal; and that the intervals between *mi* and *fa*, and between *ſi* and *ut*, are likewiſe equal among themſelves, but conſiſt almoſt only of half the former. This fact is known and recogniſed by every one: the reaſon for it ſhall be given in the ſequel; in the mean time every one may aſcertain its reality by the aſſiſtance of an experiment (A).

7. It is for this reaſon that they have called the interval from *mi* to *fa*, and from *ſi* to *ut*, a ſemitone; whereas thoſe between *ut* and *re*, *re* and *mi*, *fa* and *ſol*, *ſol* and *la*, *la* and *ſi*, are tones.

*See the figure marked A. †See *Interval.*

The *tone* is likewiſe called a *ſecond major* *, and the *ſemitone* a *ſecond minor* †.

8. To deſcend or riſe diatonically, is to deſcend or riſe from one ſound to another by the interval of a tone or of a ſemitone, or in general by ſeconds, whether major or minor; as from *re* to *ut*, or from *ut* to *re*, from *fa* to *mi*, or from *mi* to *fa*.

II. *The Terms by which the different Intervals of the Gammut are denominated.*

Definitions.

100 Third minor, what. 9. An interval compoſed of a tone and a ſemitone, as from *mi* to *ſol*, from *la* to *ut*, or from *re* to *fa*, is called a *third minor*.

101 Third major, what. An interval compoſed of two full tones, as from *ut* to *mi*, from *fa* to *la*, or from *ſol* to *ſi*, is called a *third major*.

102 Fourth, what. An interval compoſed of two tones and a ſemitone, as from *ut* to *fa*, or from *ſol* to *ut*, is called a *fourth*.

103 Triton, what. An interval conſiſting of three full tones, as from *fa* to *ſi*, is called a *triton* or *fourth redundant*.

104 Fifth, what. An interval conſiſting of three tones and a ſemitone, as from *ut* to *ſol*, from *fa* to *ut*, from *re* to *la*, or from *mi* to *ſi*, &c. is called a *fifth*.

105 Sixth minor, what. An interval compoſed of three tones and two ſemitones, as from *mi* to *ut*, is called a *ſixth minor*.

106 Sixth major, what. An interval compoſed of four tones and a ſemitone, as from *ut* to *la*, is called a *ſixth major*.

107 Seventh minor, what. An interval conſiſting of four tones and two ſemitones, as from *re* to *ut*, is called a *ſeventh minor*.

108 Seventh major, what. An interval compoſed of five tones and a ſemitone, as from *ut* to *ſi*, is called a *ſeventh major*.

And

(A) This experiment may be eaſily tried. Let any one ſing the ſcale of *ut, re, mi, fa, ſol, la, ſi, UT*, C, D, E, F, G, A, B, C, it will be immediately obſerved without difficulty, that the laſt four notes of the octave *ſol, la, ſi, UT*, G, A, B, C, are quite ſimilar to the firſt *ut, re, mi, fa*; inſomuch, that if, after having ſung this ſcale, one would chooſe to repeat it, beginning with *ut* in the ſame tone which was occupied by *ſol* in the former ſcale, the note *re* of the laſt ſcale would have the ſame ſound with the note *la* in the firſt, the *mi* with the *ſi*, and the *fa* with the *ut*.

From whence it follows, that the interval between *ut* and *re*, is the ſame as between *ſol* and *la*; between *re* and *mi*, as between *la* and *ſi*; and *mi* and *fa*, as between *ſi* and *ut*.

It will likewiſe be found, that from *re* to *mi*, from *fa* to *ſol*, there is the ſame interval as from *ut* to *re*. To be convinced of this, we need only ſing the ſcale once more; then ſing it again, beginning with *ut*, in this laſt ſcale, in the ſame tone which was given to *re* in the firſt; and it will be perceived, that the *re* in the ſecond ſcale will have the ſame ſound, at leaſt as far as the ear can diſcover, with the *mi* in the former ſcale; from whence it follows, that the difference between *re* and *mi* is, at leaſt as far as the ear can perceive, equal to that between *ut* and *re*. It will alſo be found, that the interval between *fa* and *ſol* is, ſo far as our ſenſe can determine, the ſame with that between *ut* and *re*.

This experiment may perhaps be tried with ſome difficulty by thoſe who are not inured to form the notes and change the key; but ſuch may very eaſily perform it by the aſſiſtance of a harpſichord, by means of which the performer will be ſaved the trouble of retaining the ſounds in one intonation whilſt he performs another. In touching upon this harpſichord the keys *ſol, la, ſi, ut*, and in performing with the voice at the ſame time *ut, re, mi, fa*, in ſuch a manner that the ſame ſound may be given to *ut* in the voice with that of the key *ſol* in the harpſichord, it will be found that *re* in the vocal intonation ſhall be the ſame with *la* upon the harpſichord, &c.

It will be found likewiſe by the ſame harpſichord, that if one ſhould ſing the ſcale beginning with *ut* in the ſame tone with *mi* on the inſtrument, the *re* which ought to have followed *ut*, will be higher by an extremely perceptible degree than the *fa* which follows *mi*: thus it may be concluded, that the interval between *mi* and *fa* is leſs than between *ut* and *re*; and if one would riſe from *fa* to another ſound which is at the ſame diſtance from *fa* as *fa* from *mi*, he would find in the ſame manner, that the interval from *mi* to this new ſound is almoſt the ſame as that between *ut* and *re*. The interval then from *mi* to *fa* is nearly half of that between *ut* and *re*.

Since then, in the ſcale thus divided, *ut, re, mi, fa, ſol, la, ſi, Ut*, the firſt diviſion is perfectly like the laſt; and ſince the intervals between *ut* and *re*, between *re* and *mi*, and between *fa* and *ſol*, are equal; it follows, that the intervals between *ſol* and *la*, and between *la* and *ſi*, are likewiſe equal to every one of the three intervals between *ut* and *re*, between *re mi*, and between *fa* and *ſol*; and that the intervals between *mi* and *fa* and between *ſi* and *ut* are alſo equal, but that they only conſtitute one half of the others.

Definitions.

109 Octave, what.

And in ſhort, an interval conſiſting of five tones and two ſemitones, as from *ut* to *UT*, is called an *octave*.

A great many of the intervals which have now been mentioned, are ſtill ſignified by other names, as may be ſeen in the beginning of the ſecond part; but thoſe which we have now given are the moſt common, and the only terms which our preſent purpoſe demands.

110 Uniſon, what.

10. Two ſounds equally high, or equally low, however unequal in their force, are ſaid to be in *uniſon* one with the other.

11. If two ſounds form between them any interval, whatever it be, we ſay, that the higheſt when aſcending is in that interval with relation to the loweſt; and when deſcending, we pronounce the loweſt in the ſame interval with relation to the higheſt. Thus in the third minor *mi*, *ſol*, where *mi* is the loweſt and *ſol* the higheſt ſound, *ſol* is a third minor from *mi aſcending*, and *mi* is third minor from *ſol in deſcending*.

12. In the ſame manner, if, ſpeaking of two ſonorous bodies, we ſhould ſay, that the one is a fifth above the other *in aſcending*; this infers that the ſound given by the one is at the diſtance of a fifth *aſcending* from the ſound given by the other.

III. *Of Intervals greater than the Octave.*

See fig. B.

13. If, after having ſung the ſcale *ut*, *re*, *mi*, *fa*, *ſol*, *la*, *ſi*, *UT*, one would carry this ſcale ſtill farther in aſcent, it would be diſcovered without difficulty that a new ſcale would be formed, UT, RE, MI, FA, &c. entirely ſimilar to the former, and of which the ſounds will be an octave aſcending, each to its correſpondent note in the former ſcale: thus RE, the ſecond note of the ſecond ſcale, will be an octave in aſcent to the *re* of the firſt ſcale; in the ſame manner MI ſhall be the octave to *mi*, &c. and ſo of the reſt.

Definitions.

111 Ninth, what.

14. As there are nine notes from the firſt *ut* to the ſecond RE, the interval between theſe two ſounds is called a *ninth*, and this ninth is compoſed of ſix full tones and two ſemitones. For the ſame reaſon the interval from *ut* to FA is called an *eleventh*, and the interval between *ut* and SOL, a *twelfth*, &c.

112 Eleventh and twelfth what.

It is plain that the *ninth* is the octave of the *ſecond*, the *eleventh* of the *fourth*, and the *twelfth* of the *fifth*, &c.

§ See *Interval* and *Double Octave.*

The octave above the octave of any ſound is called a *double octave* §; the octave of the double octave is called a *triple octave*, and ſo of the reſt.

The double octave is likewiſe called a *fifteenth*; and for the ſame reaſon the double octave of the third is called a *ſeventeenth*, the double octave of the fifth a *nineteenth*, &c. (B).

IV. *What is meant by Sharps and Flats.*

113 Sharps and flats, what. See *Interval.*

15. It is plain that one may imagine the five tones which enter into the ſcale, as divided each into two ſemitones; thus one may advance from *ut* to *re*, forming in his progreſs an intermediate ſound, which ſhall be higher by a ſemitone than *ut*, and lower in the ſame degree than *re*. A ſound in the ſcale is called *ſharp*, when it is raiſed by a ſemitone; and it is marked with this character ♯: thus *ut* ♯ ſignifies *ut ſharp*, that is to ſay, *ut* raiſed by a ſemitone above its pitch in the natural ſcale. A ſound in the ſcale depreſſed by a ſemitone is called *flat*, and is marked thus, ♭: thus *la* ♭ ſignifies *la flat*, or *la* depreſſed by a ſemitone.

V. *What is meant by Conſonances and Diſſonances.*

114 Conſonance, what. See *Chord.*

16. A chord compoſed of ſounds whoſe union or coaleſcence pleaſes the ear is called a *conſonance*; and the ſounds which form this chord are ſaid to be conſonant

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(B) Let us ſuppoſe two vocal ſtrings formed of the ſame matter, of the ſame thickneſs, and equal in their tenſion, but unequal in their length, it will be found by experience.

1*ſt*, That if the ſhorteſt is equal to half the longeſt, the ſound which it will produce muſt be an octave above the ſound produced by the longeſt.

2*dly*, That if the ſhorteſt conſtitutes a third part of the longeſt, the ſound which it produces muſt be a twelfth above the ſound produced by the longeſt.

3*dly*, That if it conſtitutes the fifth part, its ſound will be a ſeventeenth above.

Beſides, it is a truth demonſtrated and generally admitted, that in proportion as one muſical ſtring is leſs than another, the vibrations of the leaſt will be more frequent (that is to ſay, its departures and returns through the ſame ſpace) in the ſame time; for inſtance, in an hour, a minute, a ſecond, &c. in ſuch a manner that one ſtring which conſtitutes a third part of another, forms three vibrations, whilſt the largeſt has only accompliſhed one. In the ſame manner, a ſtring which is one half leſs than another, performs two vibrations, whilſt the other only completes one; and a ſtring which is only the fifth part of another, will perform five vibrations in the ſame time which is occupied by the other in one.

From thence it follows, that the ſound of a ſtring is proportionally higher or lower, as the number of its vibrations is greater or ſmaller in a given time; for inſtance, in a ſecond.

It is for that reaſon, that if we repreſent any ſound whatever by 1, one may repreſent the octave above by 2, that is to ſay, by the number of vibrations formed by the ſtring which produces the octave, whilſt the longeſt ſtring only vibrates once; in the ſame manner we may repreſent the twelfth above the ſound 1 by 3, the ſeventeenth major above 5, &c. But it is very neceſſary to remark, that by theſe numerical expreſſions, we do not pretend to compare ſounds as ſuch; for ſounds in themſelves are nothing but mere ſenſations, and it cannot be ſaid of any ſenſation that it is double or triple to another: thus the expreſſions 1, 2, 3, &c. employed to denominate a ſound, its octave above, its twelfth above, &c. ſignify only, that if a ſtring performs a certain number of vibrations, for inſtance, in a ſecond, the ſtring which is in the octave above ſhall double the number in the ſame time, the ſtring which is in the twelfth above ſhall triple it, &c.

Thus to compare ſounds among themſelves is nothing elſe than to compare among themſelves the numbers of vibrations which are formed in a given time by the ſtrings that produce theſe ſounds.

Definitions. nant one with relation to the other. The reaſon of this denomination is, that a chord is found more perfect, as the ſounds which form it coaleſce more cloſely among themſelves.

17. The octave of a ſound is the moſt perfect of conſonances of which that ſound is ſuſceptible; then the fifth, afterwards the third, &c. This is a fact founded on experiment.

115 Diſſonance, what. 18. A number of ſounds ſimultaneouſly produced whoſe union is diſpleaſing to the ear is called a *diſſonance*, and the ſounds which form it are ſaid to be diſſonant one with relation to the other. The ſecond, the triton, and the ſeventh of a ſound, are diſſonants with relation to it. Thus the ſounds *ut re*, *ut ſi*, or *fa ſi*, &c. ſimultaneouſly heard, form a diſſonance. The reaſon which renders diſſonance diſagreeable, is, that the ſounds which compoſe it, ſeem by no means coaleſcent to the ear, and are heard each of them by itſelf as diſtinct ſounds, though produced at the ſame time. Definitions. See *Diſcord.*

PART I. THEORY OF HARMONY.

CHAP I. *Preliminary and Fundamental Experiments.*

EXPERIMENT I.

19. WHEN a ſonorous body is ſtruck till it gives a ſound, the ear, beſides the principal ſound and its octave, perceives two other ſounds very high, of which one is the twelfth above the principal ſound, that is to ſay, the octave to the fifth of that ſound; and the other is the ſeventeenth major above the ſame ſound, that is to ſay, the double octave of its third major.

20. This experiment is peculiarly ſenſible upon the thick ſtrings of the violoncello, of which the ſound being extremely low, gives to an ear, though not very much practiſed, an opportunity of diſtinguiſhing with ſufficient eaſe and clearneſs the twelfth and ſeventeenth now in queſtion (c).

21. The principal ſound is called the *generator* * ; * See *Generator.*

(c) Since the octave above the ſound 1 is 2, the octave below that ſame ſound ſhall be $\frac{1}{2}$; that is to ſay, that the ſtring which produces this octave ſhall have performed half its vibration, whilſt the ſtring which produces the ſound 1 ſhall have completed one. To obtain therefore the octave above any ſound, the operator muſt multiply the quantity which expreſſes the ſound by 2; and to obtain the octave below, he muſt on the contrary divide the ſame quantity by 2.

It is for that reaſon that if any ſound whatever, for inſtance *ut*, is denominated	1
Its octave above will be	2
Its double octave above	4
Its triple octave above	8
In the ſame manner its octave below will be	$\frac{1}{2}$
Its double octave below	$\frac{1}{4}$
Its triple octave below	$\frac{1}{8}$
And ſo of the reſt.	
Its twelfth above	3
Its twelfth below	$\frac{1}{3}$
Its 17th major above	5
Its 17th major below	$\frac{1}{5}$

The fifth then above the ſound 1 being the octave beneath the twelfth, ſhall be, as we have immediately obſerved, $\frac{3}{2}$; which ſignifies that this ſtring performs $\frac{3}{2}$ vibrations; that is to ſay, one vibration and a half during a ſingle vibration of the ſtring which gives the ſound 1.

To obtain the fourth above the ſound 1, we muſt take the twelfth below that ſound, and the double octave above that twelfth. In effect, the twelfth below *ut*, for inſtance, is *fa*, of which the double octave *fa* is the fourth above *ut*. Since then the twelfth below 1 is $\frac{1}{3}$, it follows that the double octave above this twelfth, that is to ſay, the fourth from the ſound 1 in aſcending, will be $\frac{1}{3}$ multiplied by 4, or $\frac{4}{3}$.

In ſhort, the third major being nothing elſe but the double octave beneath the ſeventeenth, it follows, that the third major above the ſound 1 will be 5 divided by 4, or in other words $\frac{5}{4}$.

The third major of a ſound, for inſtance the third major *mi*, from the ſound *ut*, and its fifth *ſol*, form between them a third minor *mi*, *ſol*; now *mi* is $\frac{5}{4}$, and *ſol* $\frac{3}{2}$, by what has been immediately demonſtrated: from whence it follows, that the third minor, or the interval between *mi* and *ſol*, ſhall be expreſſed by the relation of the fraction $\frac{5}{4}$ to the fraction $\frac{3}{2}$.

To determine this relation, it is neceſſary to remark, that $\frac{5}{4}$ are the ſame thing with $\frac{12}{8}$, and that $\frac{3}{2}$ are the ſame thing with $\frac{10}{8}$: ſo that $\frac{5}{4}$ ſhall be to $\frac{3}{2}$ in the ſame relation as $\frac{10}{8}$ to $\frac{12}{8}$; that is to ſay, in the ſame relation as 10 to 12, or as 5 to 6. If, then, two ſounds form between themſelves a third minor, and that the firſt is repreſented by 5, the ſecond ſhall be expreſſed by 6; or, what is the ſame thing, if the firſt is repreſented by 1, the ſecond ſhall be expreſſed by $\frac{6}{5}$.

Thus

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and the two other ſounds which it produces, and with which it is accompanied, are, incluſive of its octave, called its *harmonics* §.

116 Generator, what.

§ See *Harmonic*.

EXPERIMENT II.

22. There is no perſon inſenſible of the reſemblance which ſubſiſts between any ſound and its octave, whether above or below. Theſe two ſounds, when heard together, almoſt entirely coaleſce in the organ of ſenſation. We may beſides be convinced (by two facts which are extremely ſimple) of the facility with which one of theſe ſounds may be taken for the other.

Let it be ſuppoſed that any perſon has an inclination to ſing a tune, and having at firſt begun this air upon a pitch too high or too low for his voice, ſo that he is obliged, leſt he ſhould ſtrain himſelf too much, to ſing the tune in queſtion on a key higher or lower than the firſt; I affirm, that, without being initiated in the art of muſic, he will naturally take his new key in the octave below or the octave above the firſt; and that in order to take this key in any other interval except the octave, he will find it neceſſary to exert a ſenſible degree of attention. This is a fact of which we may eaſily be perſuaded by experience.

Another fact. Let any perſon ſing a tune in our preſence, and let it be ſung in a tone too high or too low for our voice; if we wiſh to join in ſinging this air, we naturally take the octave below or above, and frequently, in taking this octave, we imagine it to be the uniſon (D).

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CHAP. II. *The Origin of the Modes Major and Minor; of the moſt natural Modulation, and the moſt perfect Harmony.*

23. To render our ideas ſtill more preciſe and permanent, we ſhall call the tone produced by the ſonorous body *ut*: it is evident, by the firſt experiment, that this ſound is always attended by its 12th and 17th major; that is to ſay, with the octave of *ſol*, and the double octave of *mi*.

117 Fundamental and harmonics, what.

24. This octave of *ſol* then, and this double octave of *mi*, produce the moſt perfect chord which can be joined with *ut*, ſince that chord is the work and choice of nature (E).

118 Harmony reduced to chords, fifths, and octaves.

25. For the ſame reaſon, the modulation formed by *ut* with the octave of *ſol* and the double octave of *mi*, ſung one after the other, would likewiſe be the moſt ſimple and natural of all modulations which do not deſcend or aſcend directly in the diatonic order, if our voices had ſufficient compaſs to form intervals ſo great without difficulty: but the eaſe and freedom with which

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Thus the third minor, an harmonic ſound which is even found in the protracted and coaleſcent tones of a ſonorous body between the ſound *mi* and *ſol*, an harmonic of the principal ſound, may be expreſſed by the fraction $\frac{6}{5}$.

N. B. One may ſee by this example, that in order to compare two ſounds one with another which are expreſſed by fractions, it is neceſſary firſt to multiply the numerator of the fraction which expreſſes the firſt by the denominator of the fraction which expreſſes the ſecond, which will give a primary number; as here the numerator 5 of the fraction $\frac{5}{4}$, multiplied by 2 of the fraction $\frac{1}{2}$, has given 10. Afterwards may be multiplied the numerator of the ſecond fraction by the denominator of the firſt, which will give a ſecondary number, as here 12 is the product of 4 multiplied by 3; and the relation between theſe two numbers (which in the preceding example are 10 and 12), will expreſs the relation between theſe ſounds, or, what is the ſame thing, the interval which there is between the one and the other; in ſuch a manner, that the farther the relation between theſe ſounds departs from unity, the greater the interval will be.

Such is the manner in which we may compare two ſounds one with another whoſe numerical value is known. We ſhall now ſhow the manner how the numerical expreſſion of a ſound may be obtained, when the relation which it ought to have with another ſound is known whoſe numerical expreſſion is given.

Let us ſuppoſe, for example, that the third major of the fifth $\frac{3}{2}$ is ſought. That third major ought to be, by what has been ſhown above, the $\frac{5}{4}$ of the fifth; for the third major of any ſound whatever is the $\frac{5}{4}$ of that ſound. We muſt then look for a fraction which expreſſes the $\frac{5}{4}$ of $\frac{3}{2}$; which is done by multiplying the numerators and denominators of both fractions one by the other, from whence reſults the new fraction $\frac{15}{8}$. It will likewiſe be found that the fifth of the fifth is $\frac{9}{4}$, becauſe the fifth of the fifth is the $\frac{3}{2}$ of $\frac{3}{2}$.

Thus far we have only treated of fifths, fourths, thirds major and minor, in aſcending; now it is extremely eaſy to find by the ſame rules the fifths, fourths, thirds major and minor in deſcending. For ſuppoſe *ut* equal to 1, we have ſeen that its fifth, its fourth, its third, its major and minor in aſcending, are $\frac{3}{2}$, $\frac{4}{3}$, $\frac{5}{4}$, $\frac{6}{5}$. To find its fifth, its fourth, its third, its major and minor in deſcending, nothing more is neceſſary than to reverſe theſe fractions, which will give $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$.

(D) It is not then imagined that we change the value of a ſound in multiplying or dividing it by 2, by 4, or by 8, &c. the number which expreſſes theſe ſounds, ſince by theſe operations we do nothing but take the ſimple, double, or triple octave, &c. of the ſound in queſtion, and that a ſound coaleſces with its octave.

(E) The chord formed with the twelfth and ſeventeenth major united with the principal ſound, being exactly conformed to that which is produced by nature, is likewiſe for that reaſon the moſt agreeable of all; eſpecially when the compoſer can proportion the voices and inſtruments together in a proper manner to give this chord its full effect. M. Rameau has executed this with the greateſt ſucceſs in the opera of *Pygmalion*, page 34. where Pygmalion ſings with the chorus, *L'amour triomphe*, &c.: in this paſſage of the chorus, the two parts of the vocal and inſtrumental baſſes give the principal ſound and its octave; the firſt part above, or treble, and that of the counter-tenor, produce the ſeventeenth major, and its octave, in deſcending; and in ſhort, the ſecond part, or tenor above, gives the twelfth.

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which we can ſubſtitute its octave to any ſound, when it is more convenient for the voice, afford us the means of repreſenting this modulation.

119 Mode major, what.

26. It is on this account that, after having ſung the tone *ut*, we naturally modulate the third *mi*, and the fifth *ſol*, inſtead of the double octave of *mi*, and the octave of *ſol*; from whence we form, by joining the octave of the ſound *ut*, this modulation, *ut*, *mi*, *ſol*, *ut*, which in effect is the ſimpleſt and eaſieſt of them all; and which likewiſe has its origin even in the protracted and compounded tones produced by a ſonorous body.

See *Mode.* See likewiſe *Interval.*

27. The modulation *ut*, *mi*, *ſol*, *ut*, in which the chord *ut*, *mi*, is a third major, conſtitutes that kind of harmony or melody which we call the *mode major*; from whence it follows, that this mode reſults from the immediate operation of nature.

120 Mode minor, what.

28. In the modulation *ut*, *mi*, *ſol*, of which we have now been treating, the ſounds *mi* and *ſol* are ſo proportioned one to the other, that the principal ſound *ut* (art. 19.) cauſes both of them to reſound; but the ſecond tone *mi* does not cauſe *ſol* to reſound, which only forms the interval of a third minor.

29. Let us then imagine, that, inſtead of this ſound *mi*, one ſhould ſubſtitute between the ſounds *ut* and *ſol* another note which (as well as the ſound *ut*) has the power of cauſing *ſol* to reſound, and which is, however, different from the ſound *ut*; the ſound which we explore ought to be ſuch, by art. 19. that it may have for its 17th major *ſol*, or one of the octaves of *ſol*; of conſequence the ſound which we ſeek ought to be a 17th major below *ſol*, or, what is the ſame thing, a third major below the ſame *ſol*. Now the ſound *mi* being a third minor beneath *ſol*, and the third major being (art. 9.) greater by a ſemitone than the third minor, it follows, that the ſound of which we are in ſearch ſhall be a ſemitone beneath the natural *mi*, and of conſequenee *mi* ♭.

30. This new arrangement, *ut*, *mi* ♭, *ſol*, in which the ſounds *ut* and *mi* ♭ have both the power of cauſing *ſol* to reſound, though *ut* does not cauſe *mi* ♭ to reſound, is not indeed equally perfect with the firſt arrangement *ut*, *mi*, *ſol*; becauſe in this the two ſounds *mi* and *ſol* are both the one and the other generated by the principal ſound *ut*; whereas, in the other, the ſound *mi* ♭ is not generated by the ſound *ut*; but this arrangement *ut*, *mi* ♭, *ſol*, is likewiſe dictated by nature (art. 19.), though leſs immediately than the former; and accordingly experience evinces that the ear accommodates itſelf almoſt as well to the latter as to the former.

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121 Origin of mode minor. See *Mode.* See alſo *Interval.*

31. In this modulation or chord *ut*, *mi* ♭, *ſol*, *ut*, it is evident that the third from *ut* to *mi* ♭ is minor; and ſuch is the origin of that mode which we call *minor* (F).

122 Perfect chords, what.

32. The moſt perfect chords then are, 1. All chords related one to another, as *ut*, *mi*, *ſol*, *ut*, conſiſting of any ſound of its third major, of its fifth, and of its octave. 2. All chords related one to another, as *ut* *mi* ♭, *ſol*, *ut*, conſiſting of any ſound, of its third minor, of its fifth, and of its octave. In effect, theſe two kinds of chords are exhibited by nature; but the firſt more immediately than the ſecond. The firſt are called *perfect chords major*, the ſecond *perfect chords minor*.

Chap. III. *Of the Series which the Fifth requires, and of the Laws which it obſerves.*

123 Fundamental baſs, what.

33. Since the ſound *ut* cauſes the ſound *ſol* to be heard, and is itſelf heard in the ſound *fa*, which ſounds *ſol* and *fa* are its two-twelfths, we may imagine a modulation compoſed of that ſound *ut* and its two-twelfths, or, which is the ſame thing (art. 22.), of its two-fifths, *fa* and *ſol*, the one below, the other above; which gives the modulation or ſeries of fifths *fa*, *ut*, *ſol*, which I call the *fundamental baſs* of *ut* by fifths.

We ſhall find in the ſequel (Chap. XVIII.), that there may be ſome fundamental baſes by thirds, deduced from the two ſeventeenths, of which the one is an attendant of the principal ſound, and of which the other includes that ſound. But we muſt advance ſtep by ſtep, and ſatisfy ourſelves at preſent to conſider immediately the fundamental baſes by fifths.

34. Thus, from the ſound *ut*, one may make a tranſition indifferently to the ſound *ſol*, or to the ſound *fa*.

35. One may, for the ſame reaſon, continue this kind of fifths in aſcending, and in deſcending, from *ut*, in this manner:

mi ♭, *ſi* ♭, *fa*, *ut*, *ſol*, *re*, *la*, &c.

And from this ſeries of fifths one may paſs to any ſound which immediately precedes or follows it.

36. But it is not allowed in the ſame manner to paſs

(F) The origin which we have here given of the mode minor, is the moſt ſimple and natural that can poſſibly be given. In the firſt edition of this treatiſe, I had followed M. Rameau in deducing it from the following experiment.—If you put in vibration a muſical ſtring AB, and if there are at the ſame time contiguous to this two other ſtrings CF, LM, of which the firſt ſhall be a twelfth below the ſtring AB, and the ſecond LM a ſeventeenth major below the ſame AB, the ſtrings CF, LM, will vibrate without being ſtruck as ſoon as the ſtring AB ſhall give a ſound, and divide themſelves by a kind of undulation, the firſt into three, the laſt into five equal parts; in ſuch a manner, that, in the vibration of the ſtring CF, you may eaſily diſtinguiſh two points at reſt D, E, and in the tremulous motion of the ſtring LM four acquieſcent points N, O, P, Q, all placed at equal diſtances from each other, and dividing the ſtrings into three or five equal parts. In this experiment, ſays M. Rameau, if we repreſent by *ut* the tone of the ſtring AB, the two other ſtrings will repreſent the ſounds *fa* and *la* ♭; and from thence M. Rameau deduces the modulation *fa*, *la* ♭, *ut*, and of conſequence the mode minor. The origin which we have aſſigned to the minor mode in this new edition, appears to me more direct and more ſimple, becauſe it preſuppoſes no other experiment than that of art. 19. and becauſe alſo the fundamental ſound *ut* is ſtill retained in both the modes, without being obliged, as M. Rameau found himſelf, to change it into *fa*. See fig. C.

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pass from one sound to another which is not immediately contiguous to it; for instance, from *ut* to *re*, or from *re* to *ut*: for this very simple reason, that the sound *re* is not contained in the sound *ut*, nor the sound *ut* in that of *re*; and thus these sounds have not any alliance the one with the other, which may authorise the transition from one to the other.

124 Exception to the rule.

125 Two perfect chords in succession proscribed.

37. And as these sounds *ut* and *re*, by the first experiment, naturally bring along with them the perfect chords consisting of greater intervals *ut*, *mi*, *sol*, *ut*, *re*, *fa*♯, *la*, *re*; hence may be deduced this rule, That two perfect chords, especially if they are major (G), cannot succeed one another diatonically in a fundamental bass; we mean, that in a fundamental bass two sounds cannot be diatonically placed in succession, each of which, with its harmonics, forms a perfect chord, especially if this perfect chord be major in both.

Chap. IV. *Of Modes in general.*

126 Mode in general, what.

38. A *mode*, in music, is nothing else but the order of sounds prescribed, as well in harmony as melody, by the series of fifths. Thus the three sounds *fa*, *ut*, *sol*, and the harmonics of each of these three sounds, that is to say, their thirds major and their fifths, compose all the major modes which are proper to *ut*.

127 Modes, how represented by the series of fifths.

39. The series of fifths then, or the fundamental bass *fa*, *ut*, *sol*, of which *ut* holds the middle space, may be regarded as representing the mode of *ut*. One may likewise take the series of fifths, or fundamental bass, *ut*, *sol*, *re*, as representing the mode of *sol*; in the same manner *si* ♭, *fa*, *ut*, will represent the mode of *fa*.

By this we may see, that the mode of *sol*, or rather the fundamental bass of that mode, has two sounds in common with the fundamental bass of the mode of *ut*. It is the same with the fundamental bass of the mode *fa*.

128 Principal mode, and adjuncts, what. See *Adjunct*.

40. The mode of *ut* (*fa*, *ut*, *sol*) is called the *principal mode* with respect to the modes of these two fifths, which are called its two *adjuncts*.

129 Modes relished in proportion as their sounds are common.

41. It is then, in some measure, indifferent to the ear whether a transition be made to the one or to the other of these adjuncts, since each of them has equally two sounds in common with the principal mode. Yet the mode of *sol* seems a little more eligible: for *sol* is heard amongst the harmonics of *ut*, and of consequence is implied and signified by *ut*; whereas *ut* does not cause *fa* to be heard, though *ut* is included in the same sound *fa*. It is hence that the ear, affected by the mode of *ut*, is a little more prepossessed for the mode of *sol* than for that of *fa*. Nothing likewise is more frequent, nor more natural, than to pass from the mode of *ut* to that of *sol*.

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130 Dominant and sub-dominant, what. See *Dominant*.

42. It is for this reason, as well as to distinguish the two fifths one from the other, that we call *sol* the fifth above the generator the *dominant* sound, and the fifth *fa* beneath the generator the *subdominant*.

131 Transition to contiguous sounds, how to be managed.

43. It remains to add, as we have seen in the preceding chapter, that, in the series of fifths, we may indifferently pass from one sound to that which is contiguous: In the same manner, and for the same reason, one may pass from the mode of *sol* to the mode of *re*, after having made a transition from the mode of *ut* to the mode of *sol*, as from the mode of *fa* to the mode of *si* ♭. But it is necessary, however, to observe, that the ear which has been immediately affected with the principal mode feels always a strong propensity to return to it. Thus the further the mode to which we make a transition is removed from the principal mode, the less time we ought to dwell upon it; or rather, to speak in the terms of the art, the less ought the phrase (‡*aa*) of that mode to be protracted.

Chap. V. *Of the Formation of the Diatonic Scale as used by the Greeks.*

44. From this rule, that two sounds which are contiguous may be placed in immediate succession in the series of fifths, *fa*, *ut*, *sol*, it follows, that one may form this modulation, or this fundamental bass, by fifths, *sol*, *ut*, *sol*, *ut fa*, *ut*, *fa*.

45. Each of the sounds which forms this modulation brings necessarily along with itself its third major, its fifth, and its octave; insomuch that he who, for instance, sings the note *sol*, may be reckoned to sing at the same time the notes *sol*, *si*, *re*, *sol*: in the same manner the sound *ut* in the fundamental bass brings along with it this modulation, *ut*, *mi*, *sol*, *ut*; and, in short, the same sound *fa* brings along with it *fa*, *la*, *ut*, *fa*. This modulation then, or this fundamental bass,

sol, *ut*, *sol*, *ut*, *fa*, *ut*, *fa*,

gives the following diatonic series,

si, *ut*, *re*, *mi*, *fa*, *sol*, *la*;

which is precisely the diatonic scale of the Greeks. We are ignorant upon what principles they had formed this scale; but it may be sensibly perceived, that that series arises from the bass *sol*, *ut*, *sol*, *ut*, *fa*, *ut*, *fa*; and that of consequence this bass is justly called *fundamental*, as being the real primitive modulation, that which

See fig. D.

132 Formation of the Greek diatonic scale by the fundamental bass.

See D.

(G) I say *especially if they are major*; for in the major chord *re*, *fa*♯, *la*, *re*, besides that the sounds *ut* and *re* have no common harmonical relation, and are even dissonant between themselves (Art. 18.), it will likewise be found, that *fa*♯ forms a dissonance with *ut*. The minor chord *re*, *fa*, *la*, *re*, would be more tolerable, because the natural *fa* which occurs in this chord carries along with it its fifth *ut*, or rather the octave of that fifth: It has likewise been sometimes the practice of composers, though rather by a licence indulged them than strictly agreeable to their art, to place a minor in diatonic succession to a major chord.

(‡*aa*) As the mere English reader, unacquainted with the technical phraseology of music, may be surprised at the use of the word *phrase* when transferred from language to that art, we have thought proper to insert the definition of Rousseau.

A *phrase*, according to him, is in melody a series of modulations, or in harmony a succession of chords, which form without interruption a sense more or less complete, and which terminate in a repose by a cadence more or less perfect.

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conducts the ear, and which it feels to be implied in the diatonic modulation, *ſi*, *ut*, *re*, *mi*, *fa*, *ſol*, *la*. (H).

46. We ſhall be ſtill more convinced of this truth by the following remarks.

In the modulation *ſi*, *ut*, *re*, *mi*, *fa*, *ſol*, *la*, the ſounds *re* and *fa* form between themſelves a third minor, which is not ſo perfectly true as that between *mi* and *ſol* (1). Nevertheleſs, this alteration in the third minor between *re* and *fa* gives the ear no pain, becauſe that *re* and that *fa*, which do not form between themſelves a true third minor, form, each in particular, conſonances perfectly juſt with the ſounds in the fundamental baſs which correſpond with them: for *re* in the ſcale is the true fifth of *ſol*, which anſwers to it in the fundamental baſs; and *fa* in the ſcale is the true octave of *fa*, which anſwers to it in the ſame baſs.

133 Altered intervals, no objection.

47. If, therefore, theſe ſounds in the ſcale form conſonances perfectly true with the notes which correſpond to them in the fundamental baſs, the ear gives itſelf little trouble to inveſtigate the alterations which there may be in the intervals which theſe ſounds in the ſcale form between themſelves. This is a new proof that the fundamental baſs is the genuine guide of the ear, and the true origin of the diatonic ſcale.

134 Reaſons why this ſcale includes only ſeven ſounds.

48. Moreover, this diatonic ſcale includes only ſeven ſounds, and goes no higher than *ſi*, which would be the octave of the firſt: a new ſingularity, for which a reaſon may be given by the principles above eſtabliſhed. In reality, in order that the ſound *ſi* may ſucceed immediately in the ſcale to the ſound *la*, it is neceſſary that the note *ſol*, which is the only one from whence *ſi* as a harmonic may be deduced, ſhould immediately ſucceed to the ſound *fa*, in the fundamental baſs, which is the only one from whence *la* can be harmonically deduced. Now, the diatonic ſucceſſion from *fa* to *ſol* cannot be admitted in the fundamental baſs, according to what we have remarked (art. 36.). The ſounds *la* and *ſi*, then, cannot immediately ſucceed one another in the ſcale: we ſhall ſee in the ſequel why this is not the caſe in the ſeries *ut*, *re*, *mi*, *fa*, *ſol*, *la*, *ſi*, *UT*, which begins upon *ut*; whereas the ſcale in queſtion here begins upon *ſi*.

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135 Completion of the Greek octave. See *Proſlambanomene*.

49. The Greeks likewiſe, to form an entire octave, added below the firſt *ſi* the note *la*, which they diſtinguiſhed and ſeparated from the reſt of the ſcale, and which for that reaſon they called *proſlambanomene*, that is to ſay, a ſtring or note ſubadded to the ſcale, and put before *ſi* to form the entire octave.

136 The ſcale compoſed of two ſimilar conjunctive tetrachords.

50. The diatonic ſcale *ſi*, *ut*, *re*, *mi*, *fa*, *ſol*, *la*, is compoſed of two tetrachords, that is to ſay, of two diatonic ſcales, each conſiſting of four ſounds, *ſi*, *ut*, *re*, *mi*, and *mi*, *fa*, *ſol*, *la*. Theſe two tetrachords are exactly ſimilar; for from *mi* to *fa* there is the ſame interval as from *ſi* to *ut*, from *fa* to *ſol* the ſame as from *ut* to *re*, from *ſol* to *la* the ſame as from *re* to *mi*

(H) Nothing is eaſier than to find in this ſcale the value or proportions of each ſound with relation to the ſound *ut*, which we call 1; for the two ſounds *ſol* and *fa* in the baſs are $\frac{1}{2}$ and $\frac{2}{3}$; from whence it follows,

1. That *ut* in the ſcale is the octave of *ut* in the baſs; that is to ſay, 2.
2. That *ſi* is the third major of *ſol*; that is to ſay $\frac{5}{4}$ of $\frac{3}{2}$ (note c), and of conſequence $\frac{15}{8}$.
3. That *re* is the fifth of *ſol*; that is to ſay $\frac{3}{2}$ of $\frac{1}{2}$, and of conſequence $\frac{9}{4}$.
4. That *mi* is the third major of the octave of *ut*, and of conſequence the double of $\frac{5}{4}$; that is to ſay, $\frac{5}{2}$.
5. That *fa* is the double octave of *fa* of the baſs, and conſequently $\frac{8}{3}$.
6. That *ſol* of the ſcale is the octave of *ſol* of the baſs, and conſequently 3.
7. In ſhort, that *la* in the ſcale is the third major of *fa* of the ſcale; that is to ſay, $\frac{5}{4}$ of $\frac{8}{3}$, or $\frac{10}{3}$.

Hence then will reſult the following table, in which each ſound has its numerical value above or below it.

Diatonic Scale.	$\frac{15}{8}$	2	$\frac{9}{4}$	$\frac{5}{2}$	$\frac{8}{3}$	3	$\frac{10}{3}$
	ſi,	*ut*,	*re*,	*mi*,	*fa*,	*ſol*,	*la*.
Fundamental Baſs.	*ſol*,	*ut*,	*ſol*,	*ut*,	*fa*,	*ut*,	*fa*.
	$\frac{1}{2}$	1,	$\frac{3}{2}$	1	$\frac{2}{3}$	1	$\frac{2}{3}$

And if, for the conveniency of calculation, we chooſe to call the ſound *ut*, of the ſcale 1; in this caſe there is nothing to do but to divide each of the numbers by 2, which repreſent the diatonic ſcale, and we ſhall have

$\frac{15}{16}$	1	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$
ſi,	*ut*,	*re*,	*mi*,	*fa*,	*ſol*,	*la*.

(1) In order to compare *re* with *fa*, we need only compare $\frac{9}{8}$ with $\frac{4}{3}$; the relation between theſe fractions will be (Note c) that of 9 times 3 to 8 times 4; that is to ſay, of 27 to 32: the third minor, then, from *re* to *fa*, is not true; becauſe the proportion of 27 to 32 is not the ſame with that of 5 to 6, theſe two proportions being between themſelves as 27 times 6 is to 32 times 5, that is to ſay, as 162 to 160, or as the halves of theſe two numbers, that is to ſay, as 81 to 80.

M. Rameau, when he publiſhed, in 1726, his *New theoretical and practical Syſtem of Muſic*, had not as yet found the true reaſon of the alteration in the conſonance which is between *re* and *fa*, and of the little attention which the ear pays to it. For he pretends, in the work now quoted, that there are two thirds minor, one in the proportion of 5 to 6, the other in the proportion of 27 to 32. But the opinion which he has afterwards adopted, ſeems much preferable. In reality, the genuine third minor, is that which is produced by nature between *mi* and *ſol*, in the continued tone of thoſe ſonorous bodies of which *mi* and *ſol* are the two harmonics; and that third minor, which is in the proportion of 5 to 6, is likewiſe that which takes place in the minor mode, and not that third minor which is falſe and different, being in the proportion of 27 to 32.

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mi (L): this is the reaſon why the Greeks diſtinguiſhed theſe two tetrachords; yet they joined them by the note *mi*, which is common to both, and which gave them the name of *conjunctive tetrachords*.

137 Intervals in both tetrachords equal.

51. Moreover, the intervals between any two ſounds, taken in each tetrachord in particular, are preciſely true: thus, in the firſt tetrachord, the intervals of *ut mi*, and *ſi re*, are thirds, the one major and the other minor, exactly true, as well as the fourth *ſi mi* (M); it is the ſame thing with the tetrachord *mi, fa, ſol, la*, ſince this tetrachord is exactly like the former.

138 Intervals between the notes of different tetrachords diſſimilar.

52. But the caſe is not the ſame when we compare two ſounds taken each from a different tetrachord; for we have already ſeen, that the note *re* in the firſt tetrachord forms with the note *fa* in the ſecond a third minor, which is not true. In like manner it will be found, that the fifth from *re* to *la* is not exactly true, which is evident; for the third major from *fa* to *la* is true, and the third minor from *re* to *fa* is not ſo: now, in order to form a true fifth, a third major and a third minor, which are both exactly true, are neceſſary.

139 Another reaſon for diſtinguiſhing the ſcale into two tetrachords.

53. From thence it follows, that every conſonance is abſolutely perfect in each tetrachord taken by itſelf; but that there is ſome alteration in paſſing from one tetrachord to the other. This is a new reaſon for diſtinguiſhing the ſcale into theſe two tetrachords.

140 The ſource of tones major and minor inveſtigated.

54. It may be aſcertained by calculation, that in the tetrachord *ſi, ut, re, mi*, the interval, or the tone from *re* to *mi*, is a little leſs than the interval or tone from *ut* to *re* (N). In the ſame manner, in the ſecond tetrachord *mi, fa, ſol, la*, which is, as we have proved, perfectly ſimilar to the firſt, the note from *ſol* to *la* is a little leſs than the note from *fa* to *ſol*. It is for this reaſon that they diſtinguiſh two kinds of tones; the greater tone*, as from *ut* to *re*, from *fa* to *ſol*, &c.; and the leſſer †, as from *re* to *mi*, from *ſol* to *la*, &c.

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* Greater tone. See *Interval*.

† Leſſer tone. See *Interval*.

CHAP. VI. *The formation of the Diatonic Scale among the Moderns, or the ordinary Gammut.*

141 The modern ſcale, how formed.

55. We have juſt ſhown in the preceding chapter, how the ſcale of the Greeks is formed, *ſi, ut, re, mi, fa, ſol, la*, by means of a fundamental baſs compoſed of three ſounds only, *fa, ut, ſol*: but to form the ſcale *ut, re, mi, fa, ſol, la, ſi, UT*, which we uſe at preſent, we muſt neceſſarily add to the fundamental baſs the note *re*, and form, with theſe four ſounds *fa, ut, ſol, re*, the following fundamental baſs:

ut, ſol, ut, fa, ut, ſol, re, ſol, ut; *See fig. E. See Scale.*

from whence we deduce the modulation or ſcale

ut, re, mi, fa, ſol, la, ſi, UT.

In effect (O), *ut* in the ſcale belongs to the harmony of *ut* which correſponds with it in the baſs; *re*, which is the ſecond note in the gammut, is included in the harmony of *ſol*, the ſecond note of the baſs; *mi*, the third note of the gammut, is a natural harmonic of *ut*, which is the third ſound in the baſs, &c.

142 The Greek diatonic ſcale ſimpler than ours, and why.

56. From thence it follows, that the diatonic ſcale of the Greeks is, at leaſt in ſome reſpects, more ſimple than ours; ſince the ſcale of the Greeks (chap. v.) may be formed alone from the mode proper to *ut*; whereas ours is originally and primitively formed, not only from the mode of *ut* (*fa, ut, ſol*), but likewiſe from the mode of *ſol*, (*ut, ſol, re.*)

It will likewiſe appear, that this laſt ſcale conſiſts of two parts; of which the one, *ut, re, mi, fa, ſol*, is in the

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(L) The proportion of *ſi* to *ut* is as $\frac{15}{16}$ to 1, that is to ſay as 15 to 16; that between *mi* and *fa* is as $\frac{5}{4}$ to $\frac{4}{3}$, that is to ſay (note C), as 5 times 3 to 4 times 4, or as 15 to 16: theſe two proportions then are equal. In the ſame manner, the proportion of *ut* to *re* is as 1 to $\frac{9}{8}$, or as 8 to 9; that between *fa* and *ſol* is as $\frac{4}{3}$ to $\frac{3}{2}$; that is to ſay (note C), as 8 to 9. The proportion of *mi* to *ut* is as $\frac{5}{4}$ to 1, or as 5 to 4; that between *fa* and *la* is as $\frac{5}{3}$ to $\frac{4}{3}$, or as 5 to 4: the proportions here then are likewiſe equal.

(M) The proportion of *mi* to *ut* is as $\frac{5}{4}$ to 1, or as 5 to 4, which is a true third major; that from *re* to *ſi* is as $\frac{9}{8}$ to $\frac{15}{16}$; that is to ſay, as 9 times 16 to 15 times 8, or as 9 times 2 to 15, or as 6 to 5. In like manner, we ſhall find, that the proportion of *mi* to *ſi* is as $\frac{5}{4}$ to $\frac{15}{16}$; that is to ſay, as 5 times 16 to 15 times 4, or as 4 to 3, which is a true fourth.

(N) The proportion of *re* to *ut* is as $\frac{9}{8}$ to 1, or as 9 to 8; that of *mi* to *re* is as $\frac{5}{4}$ to $\frac{9}{8}$, that is to ſay, as 40 to 36, or as 10 to 9: now $\frac{10}{9}$ is leſs removed from unity than $\frac{9}{8}$; the interval then from *re* to *mi* is a little leſs than that from *ut* to *re*.

If any one would wiſh to know the proportion which $\frac{10}{9}$ bear to $\frac{9}{8}$, he will find (note C) that it is as 8 times 10 to 9 times 9, that is to ſay, as 80 to 81. Thus the proportion of a leſſer to a greater tone is as 80 to 81; this difference between the greater and leſſer tone is what the Greeks called a *comma*.

We may remark, that this difference of a comma is found between the third minor when true and harmonical, and the ſame chord when it ſuffers alteration *re fa*, of which we have taken notice in the ſcale (note I); for we have ſeen, that this third minor thus altered is in the proportion of 80 to 81 with the true third minor.

(O) The values or eſtimates of the notes ſhall be the ſame in this as in the former ſcale, excepting only the tone *la*; for *re* being repreſented by $\frac{9}{8}$, its fifth will be expreſſed by $\frac{27}{16}$; ſo that the ſcale will be numerically ſignified thus:

1 $\frac{9}{8}$ $\frac{5}{4}$ $\frac{4}{3}$ $\frac{3}{2}$ $\frac{27}{16}$ $\frac{15}{8}$ 2

ut, re, mi, fa, ſol, la, ſi, UT.

Where you may ſee, that the note *la* of this ſcale is different from that in the ſcale of the Greeks; and that the *la* in the modern ſeries ſtands in proportion to that of the Greeks as $\frac{27}{16}$ to $\frac{5}{3}$, that is to ſay, as 81 to 80; theſe two *la*'s then likewiſe differ by a *comma*.

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the mode of *ut*; and the other, *ſol*, *la*, *ſi*, *ut*, in that of *ſol*.

143 The note *ſol* twice repeated in the diatonic ſcale from its harmonic relations to the fundamental baſs.

57. It is for this reaſon that the note *ſol* is found to be twice repeated in immediate ſucceſſion in this ſcale; once as the fifth of *ut*, which correſponds with it in the fundamental baſs; and again, as the octave of *ſol*, which immediately follows *ut* in the ſame baſs. As to what remains, theſe two conſecutive *ſol's* are otherwiſe in perfect uniſon. It is for this reaſon that we are ſatisfied with ſinging only one of them when one modulates the ſcale *ut*, *re*, *mi*, *fa*, *ſol*, *la*, *ſi*, *UT*: but this does not prevent us from employing a pauſe or repoſe, expreſſed or underſtood, after the ſound *fa*. There is no perſon who does not perceive this whilſt he himſelf ſings the ſcale.

144 The modern ſcale compoſed of two diſjunctive tetrachords of different modes.

58. The ſcale of the moderns, then, may be conſidered as conſiſting of two tetrachords, disjunctive indeed, but perfectly ſimilar one to the other, *ut*, *re*, *mi*, *fa*, and *ſol*, *la*, *ſi*, *ut*, one in the mode of *ut*, the other in that of *ſol*. For what remains, we ſhall ſee in the ſequel by what artifice one may cauſe the ſcale *ut*, *re*, *mi*, *fa*, *ſol*, *la*, *ſi*, *UT*, to be regarded as belonging to the mode of *ut* alone. For this purpoſe it is neceſſary to make ſome changes in the fundamental baſs, which we have already aſſigned: but this ſhall be explained at large in chap. xiii.

145 The mode of *ſol* introduced in the fundamental baſs productive of conveniences.

59. The introduction of the mode proper to *ſol* in the fundamental baſs has this happy effect, that the notes *fa*, *ſol*, *la*, *ſi*, may immediately ſucceed each other in aſcending the ſcale, which cannot take place (art. 48.) in the diatonic ſeries of the Greeks, becauſe that ſeries is formed from the mode of *ut* alone. From whence it follows:

1. That we change the mode at every time when we modulate three notes in ſucceſſion.

2. That if theſe three notes are ſung in ſucceſſion in the ſcale *ut*, *re*, *mi*, *fa*, *ſol*, *la*, *ſi*, *UT*, this cannot be done but by the aſſiſtance of a pauſe expreſſed or underſtood after the note *fa*; inſomuch, that the three tones *fa*, *ſol*, *la*, *ſi*, (three only becauſe the note *ſol* which is repeated is not enumerated) are ſuppoſed to belong to two different tetrachords.

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60. It ought not then any longer to ſurpriſe us, that we feel ſome difficulty whilſt we aſcend the ſcale in ſinging three tones in ſucceſſion, becauſe this is impracticable without changing the mode; and if one pauſes in the ſame mode, the fourth ſound above the firſt note will never be higher than a ſemitone above that which immediately precedes it; as may be ſeen by *ut*, *re*, *mi*, *fa*, and by *ſol*, *la*, *ſi*, *ut*, where there is no more than a ſemitone between *mi* and *fa*, and between *ſi* and *ut*.

146 Change of mode the cauſe of the difficulty in ſinging three conſecutive tones aſcending.

61. We may likewiſe obſerve in the ſcale *ut*, *re*, *mi*, *fa*, that the third minor from *re* to *fa* is not true, for the reaſons which have been already given (art. 49.). It is the ſame caſe with the third minor from *la* to *ut*, and with the third major from *fa* to *la*: but each of theſe ſounds form otherwiſe conſonances perfectly true, with their correſpondent ſounds in the fundamental baſs.

147 Intervals, though altered in themſelves, form true conſonances with the fundamental baſs.

62. The thirds *la ut*, *fa la*, which were true in the former ſcale, are falſe in this; becauſe in the former ſcale *la* was the third of *fa*, and here it is the fifth of *re*, which correſponds with it in the fundamental baſs.

148 Fewer altered conſonances in the Greek ſcale than in ours.

63. Thus it appears, that the ſcale of the Greeks contains fewer conſonances that are altered than ours (P); and this likewiſe happens from the introduction of the mode of *ſol* into the fundamental baſs (Q).

We ſee likewiſe that the value of *la* in the diatonic ſcale, a value which authors have been divided in aſcertaining, ſolely depends upon the fundamental baſs, and that it muſt be different according as the note *la* has *fa* or *re* for its baſs. See the note (O).

CHAP. VII. *Of Temperament.*

149 Temperament, why neceſſary.

64. THE alterations which we have obſerved in the intervals between particular ſounds of the diatonic ſcale, naturally lead us to ſpeak of temperament. To give a clear idea of this, and to render the neceſſity of it palpable, let us ſuppoſe that we have before us an inſtrument with keys, a harpſichord, for inſtance, conſiſting of ſeveral octaves or ſcales, of which each includes its twelve ſemitones.

Let

(P) In the ſcale of the Greeks, the note *la* being a third from *fa*, there is an altered fifth between *la* and *re*: but in ours, *la* being a fifth to *re*, produces two altered thirds, *fa la*, and *la ut*; and likewiſe a fifth altered, *la mi*, as we ſhall ſee in the following chapter. Thus there are in our ſcale two intervals more than in the ſcale of the Greeks which ſuffer alteration.

(Q) But here it may be with ſome colour objected: The ſcale of the Greeks, it may be ſaid, has a fundamental baſs more ſimple than ours; and beſides, in it there are fewer chords which will not be found exactly true: why then, notwithſtanding this, does ours appear more eaſy to be ſung than that of the Greeks? The Grecian ſcale begins with a ſemitone, whereas the intonation prompted by nature ſeems to impel us to riſe by a full tone at once. This objection may be thus anſwered. The ſcale of the Greeks is indeed better diſpoſed than ours for the ſimplicity of the baſs, but the arrangement of ours is more ſuitable to natural intonation. Our ſcale commences by the fundamental ſound *ut*, and it is in reality from that ſound that we ought to begin; it is from this that all the others naturally ariſe, and upon this that they depend; nay, if I may ſpeak ſo, in this they are included: on the contrary, neither the ſcale of the Greeks, nor its fundamental baſs, commences with *ut*; but it is from this *ut* that we muſt depart, in order to regulate our intonation, whether in riſing or deſcending: now, in aſcending from *ut*, the intonation, even of the Greek ſcale, gives the ſeries *ut*, *re*, *mi*, *fa*, *ſol*, *la*: and ſo true is it that the fundamental ſound *ut* is here the genuine guide of the ear, that if, before we modulate the ſound *ut*, we ſhould attempt to riſe to it by that note in the ſcale which is moſt immediately contiguous, we cannot reach it but by the note *ſi*, and by the ſemitone from *ſi* to *ut*. Now to make a tranſition from *ſi* to *ut*, by this ſemitone, the ear muſt of neceſſity be prediſpoſed for that modulation, and conſequently preoccupied with the mode of *ut*: if this were not the caſe, we ſhould naturally riſe from *ſi* to *ut*♯, and by this operation paſs into another mode.

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Let us chooſe in that harpſichord one of the ſtrings which will ſound the note UT; and let us tune the ſtring SOL to a perfect fifth with UT in aſcending; let us afterwards tune to a perfect fifth with this SOL the RE which is above it; we ſhall evidently perceive that this RE will be in the ſcale above that from which we ſet out: but it is alſo evident that this RE muſt have in the ſcale a *re* which correſponds with it, and which muſt be tuned a true octave below RE; and between this and SOL there ſhould be the interval of a fifth; ſo that the *re* in the firſt ſcale will be a true fourth below the SOL of the ſame ſcale. We may afterwards tune the note LA of the firſt ſcale to a juſt fifth with this laſt *re*; then the note MI in the higheſt ſcale to a true fifth with this new LA, and of conſequence the *mi* in the firſt ſcale to a true fourth beneath this ſame LA: Having finiſhed this operation, it will be found that the laſt *mi*, thus tuned, will by no means form a juſt third major from the ſound UT (R): that is to ſay, that it is impoſſible for *mi* to conſtitute at the ſame time the third major of UT and the true fifth of LA; or, what is the ſame thing, the true fourth of LA in deſcending.

See fig. F.

65. What is ſtill more, if, after having ſucceſſively and alternately tuned the ſtrings UT, SOL, *re*, LA, *mi*, in perfect fifths and fourths one from the other, we continue to tune ſucceſſively by true fifths and fourths the ſtrings *mi*, *ſi*, *fa*※, *ut*※, *ſol*※, *re*※, *mi*※, *ſi*※; we ſhall find, that, though *ſi*※, being a ſemitone higher than the natural note, ſhould be equivalent to UT natural, it will by no means form a juſt octave to the firſt *ut* in the ſcale, but be conſiderably higher (s); yet this *ſi*※ upon the harpſichord ought not to be different from the octave above UT; for every *ſi*※ and every UT is the ſame ſound, ſince the octave or the ſcale only conſiſts of twelve ſemitones.

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150 Reaſons and rules for temperament.

66. From thence it neceſſarily follows, 1. That it is impoſſible that all the octaves and all the fifths ſhould be juſt at the ſame time, particularly in inſtruments which have keys, where no intervals leſs than a ſemitone are admitted. 2. That, of conſequence, if the fifths are juſtly tuned, ſome alteration muſt be made in the octaves; now the ſympathy or ſound which ſubſiſts between any note and its octave, does not permit us to make ſuch an alteration: this perfect coaleſcence of ſound is the cauſe why the octave ſhould

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(R) The LA conſidered as the fifth of *re* is $\frac{27}{16}$, and the fourth beneath this LA will conſtitute $\frac{3}{4}$ of $\frac{27}{16}$, that is to ſay, $\frac{81}{64}$; $\frac{81}{64}$ then ſhall be the value of *mi*, conſidered as a true fourth from LA in deſcending: now *mi*, conſidered as the third major of the ſound UT, is $\frac{5}{4}$, or $\frac{80}{64}$: theſe two *mi*'s then are between themſelves in the proportion of 81 to 80; thus it is impoſſible that *mi* ſhould be at the ſame time a perfect third major from UT, and a true fourth beneath LA.

(s) In effect, if you thus alternately tune the fifth above, and the fourth below, in the ſame octave, you may here ſee what will be the proceſs of your operation.

UT, SOL, a fifth; *re* a fourth; LA a fifth; *mi* a fourth; *ſi* a fifth; *fa*※ a fourth; *ut*※ a fifth; *ſol*※ a fourth; RE※ a fifth; *la*※ a fourth; MI※ or FA a fifth; *ſi*※ a fourth: now it will be found, by a very eaſy computation, that the firſt UT being repreſented by 1, SOL ſhall be $\frac{3}{2}$, *re* $\frac{9}{8}$, LA $\frac{27}{16}$, *mi* $\frac{81}{64}$, &c. and ſo of the reſt till you arrive at *ſi*※, which will be found $\frac{531441}{262144}$. This fraction is evidently greater than the number 2, which expreſſes the perfect octave *ut* to its correſpondent UT; and the octave below *ſi*※ would be one half of the ſame fraction, that is to ſay $\frac{531441}{524288}$, which is evidently greater than UT repreſented by unity. This laſt fraction $\frac{531441}{524288}$ is compoſed of two numbers; the numerator of the fraction is nothing elſe but the number 3 multiplied 11 times in ſucceſſion by itſelf, and the denominator is the number 2 multiplied 18 times in ſucceſſion by itſelf. Now it is evident, that this fraction, which expreſſes the value of *ſi*※, is not equal to the unity which expreſſes the value of the ſound UT; though, upon the harpſichord, *ſi*※ and UT are identical. This fraction riſes above unity by $\frac{531441}{524288}$, that is to ſay, by about $\frac{1}{73}$; and this difference was called the *comma of Pythagoras*. It is palpable that this comma is much more conſiderable than that which we have already mentioned (note N), and which is only $\frac{1}{80}$.

We have already proved that the ſeries of fifths produces an *ut* different from *ſi*※, the ſeries of thirds major gives another ſtill more different. For, let us ſuppoſe this ſeries of thirds, *ut*, *mi*, *ſol*※, *ſi*※, we ſhall have *mi* equal to $\frac{5}{4}$, *ſol*※ to $\frac{125}{100}$, and *ſi*※ to $\frac{125}{64}$, whoſe octave below is $\frac{125}{128}$; from whence it appears, that this laſt *ſi* is leſs than unity (that is to ſay, than *ut*), by $\frac{3}{128}$, or by $\frac{1}{42}$, or near it: A new comma, much greater than the preceding, and which the Greeks have called *apotome major*.

It may be obſerved, that this *ſi*※, deduced from the ſeries of thirds, is to the *ſi*※ deduced from the ſeries of fifths, as $\frac{125}{128}$ is to $\frac{531441}{524288}$; that is to ſay, in multiplying by 524288, as 125 multiplied by 4096 is to 531441, or as 51200 to 531441, that is to ſay, nearly as 26 is to 27: from whence it may be ſeen, that theſe two *ſi*'s※ are very conſiderably different one from the other, and even ſufficiently different to make the ear ſenſible of it; becauſe the difference conſiſts almoſt of a minor ſemitone, whoſe value, as will afterwards be ſeen (art. 139.), is $\frac{25}{24}$.

Moreover, if, after having found the *ſol*※ equal to $\frac{25}{16}$, we then tune by fifths and by fourths, *ſol*※, *re*※, *la*※, *mi*※, *ſi*※, as we have done with reſpect to the firſt ſeries of fifths, we find that the *ſi*※ muſt be $\frac{20025}{16384}$; its difference, then, from unity, or, in other words, from UT, is $\frac{2025}{2048}$, that is to ſay, about $\frac{1}{89}$; a comma ſtill leſs than any of the preceding, and which the Greeks have called *apotome minor*.

In a word, if, after having found *mi* equal to $\frac{5}{4}$ in the progreſſion of thirds, we then tune by fifths and fourths *mi*, *ſi*, *fa*※, *ut*※, &c. we ſhall arrive at a new *ſi*※, which ſhall be $\frac{128059}{131072}$, and which will not differ from unity but by about $\frac{1}{8192}$, which is the laſt and ſmalleſt of all the commas; but it muſt be obſerved, that, in this caſe, the thirds major from *mi* to *ſol*※, from *ſol*※ to *ſi*※ or *ut*, &c. are extremely falſe, and greatly altered.

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ſhould ſerve as limits to the other intervals, and that all the notes which riſe above or fall below the ordinary ſcale, are no more than replications, *i. e.* repetitions, of all that have gone before them. For this reaſon, if the octave were altered, there could be no longer any fixed point either in harmony or melody. It is then abſolutely neceſſary to tune the *ut* or *ſi*♯ in a juſt octave with the firſt; from whence it follows, that, in the progreſſion of fifths, or what is the ſame thing, in the alternate ſeries of fifths and fourths, UT, SOL, *re*, LA, *mi*, *ſi*, *fa*♯, *ut*♯, *ſol*♯, *re*♯, *la*♯, *mi*♯, *ſi*♯, it is neceſſary that all the fifths ſhould be altered, or at leaſt ſome of them. Now, ſince there is no reaſon why one ſhould rather be altered than another, it follows, that we ought to alter them all equally. By theſe means, as the alteration is made to influence all the fifths, it will be in each of them almoſt imperceptible; and thus the fifth, which, after the octave, is the moſt perfect of all conſonances, and which we are under the neceſſity of altering, muſt only be altered in the leaſt degree poſſible.

67. It is true, that the thirds will be a little harſh: but as the interval of ſounds which conſtitutes the third, produces a leſs perfect coaleſcence than that of the fifth, it is neceſſary, ſays M. Rameau, to ſacrifice the juſtice of that chord to the perfection of the fifth; for the more perfect a chord is in its own nature, the more diſpleaſing to the ear is any alteration which can be made in it. In the octave the leaſt alteration is inſupportable.

151 Its definition.

68. This change in the intervals of inſtruments which have, or even which have not, keys, is that which we call *temperament*.

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152 Principle whence its theory may be deduced.

69. It reſults then from all that we have now ſaid, that the theory of temperament may be reduced to this queſtion—The alternate ſucceſſion of fifths and fourths having been given, UT, SOL, *re*, LA, *mi*, *ſi*, *fa*♯, *ut*♯, *ſol*♯, *re*♯, *la*♯, *mi*♯, *ſi*♯, in which *ſi*♯ or *ut* is not the true octave of the firſt UT, it is propoſed to alter all the fifths equally, in ſuch a manner that the two *ut's* may be in a perfect octave the one to the other.

153 Practical directions for temperament.

70. For a ſolution of this queſtion, we muſt begin with tuning the two *ut's* in a perfect octave the one to the other; in conſequence of which, we will render all the ſemitones which compoſe the octave as equal as poſſible. By this means (T) the alteration made in each fifth will be very conſiderable, but equal in all of them.

154 Rameau's method of temperament propoſed.

71. In this, then, the theory of temperament conſiſts: but as it would be difficult in practice to tune a harpſichord or organ by thus rendering all the ſemitones equal, M. Rameau, in his *Generation Harmonique*, has furniſhed us with the following method, to alter all the fifths as equally as poſſible.

72. Take any key of the harpſichord which you pleaſe; but let it be towards the middle of the inſtrument; for inſtance, UT: then tune the note SOL a fifth above it, at firſt with as much accuracy as poſſible; this you may imperceptibly diminiſh: tune afterwards the fifth to this with equal accuracy, and diminiſh it in the ſame manner; and thus proceed from one fifth to another

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(T) All the ſemitones being equal in the temperament propoſed by M. Rameau, it follows, that the twelve ſemitones *ut*, *ut*♯, *re*, *re*♯, *mi*, *mi*♯, &c. ſhall form a continued geometrical progreſſion; that is to ſay, a ſeries in which *ut* ſhall be to *ut*♯ in the ſame proportion as *ut*♯ to *re*, as *re* to *re*♯, &c. and ſo of the reſt.

Theſe twelve ſemitones are formed by a ſeries of thirteen ſounds, of which *UT* and its octave *ut* are the firſt and laſt. Thus to find by computation the value of each ſound in the temperament, which is the preſent object of our ſpeculations, our ſcrutiny is limited to the inveſtigation of eleven other numbers between 1 and 2 which may form with the 1 and the 2 a continued geometrical progreſſion.

However little any one is practiſed in calculation, he will eaſily find each of theſe numbers, or at leaſt a number approaching to its value. Theſe are the characters by which they may be expreſſed, which mathematicians will eaſily underſtand, and which others may neglect.

UT	*ut*♯	*re*	*re*♯	*mi*	*fa*	*fa*♯	*ſol*	*ſol*♯
	$\sqrt[12]{2}$	$\sqrt[12]{2^2}$	$\sqrt[12]{2^3}$	$\sqrt[12]{2^4}$	$\sqrt[12]{2^5}$	$\sqrt[12]{2^6}$	$\sqrt[12]{2^7}$	$\sqrt[12]{2^8}$
1	*la*	*la*♯	*ſi*	*ut*				
	$\sqrt[12]{2^9}$	$\sqrt[12]{2^{10}}$	$\sqrt[12]{2^{11}}$	$\sqrt[12]{2^{12}}$				

It is obvious, that in this temperament all the fifths are equally altered. One may likewiſe prove, that the alteration of each in particular is very inconſiderable; for it will be found, for inſtance, that the fifth from *ut* to *ſol*, which ſhould be $\frac{7}{12}$, ought to be diminiſhed by about $\frac{1}{12}$ of $\frac{1}{12}$; that is to ſay, by $\frac{1}{8\,\mathrm{T}\,6}$, a quantity almoſt inconceivably ſmall.

It is true, that the thirds major will be a little more altered; for the third major from *ut* to *mi*, for inſtance, ſhall be increaſed in its interval by about $\frac{1}{100}$: but it is better, according to M. Rameau, that the alteration ſhould fall upon the third than upon the fifth, which after the octave is the moſt perfect chord, and from the perfection of which we ought never to degenerate but as little as poſſible.

Beſides, it has appeared from the ſeries of thirds major *ut*, *mi*, *ſol*♯, *ſi*♯, that this laſt *ſi*♯ is very different from *ut* (note s); from whence it follows, that if we would tune this *ſi*♯ in uniſon with the octave of *ut*, and alter at the ſame time each of the thirds major by a degree as ſmall as poſſible, they muſt all be equally altered. This is what occurred in the temperament which we propoſe; and if in it the third be more altered than the fifth, it is a conſequence of the difference which we find between the degrees of perfection in theſe intervals; a difference with which, if we may ſpeak ſo, the temperament propoſed conforms itſelf. Thus this diverſity of alteration is ratheradvantageous than inconvenient.

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another in aſcent: and as the ear does not appretiate ſo exactly ſounds that are extremely ſharp, it is neceſſary, when by fifths you have riſen to notes extremely high, that you ſhould tune in the moſt perfect manner the octave below the laſt fifth which you had immediately formed; then you may continue always in the ſame manner; till in this proceſs you arrive at the laſt fifth from *mi*※ to *ſi*※, which ſhould of themſelves be in tune; that is to ſay, they ought to be in ſuch a ſtate, that *ſi*※, the higheſt note of the two which compoſe the fifth, may be identical with the found UT, with which you began, or at leaſt the octave of that found perfectly juſt: it will be neceſſary then to try if this UT, or its octave, forms a juſt fifth with the laſt found *mi*※ or *fa* which has been already tuned. If this be the caſe, we may be certain that the harpſichord is properly tuned. But if this laſt fifth be not true, in this caſe it will be too ſharp, and it is an indication that the other fifths have been too much diminiſhed, or at leaſt ſome of them; or it will be too flat, and conſequently diſcover that they have not been ſufficiently diminiſhed. We muſt then begin and proceed as formerly, till we find the laſt fifth in tune of itſelf, and without our immediate interpoſition (u).

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By

(u) All that remains, is to acknowledge, with M. Rameau, that this temperament is far remote from that which is now in practice: you may here ſee in what this laſt temperament conſiſts as applied to the organ or harpſichord. They begin with *UT* in the middle of the keys, and they flatten the four firſt fifths *ſol*, *re*, *la*, *mi*, till they form a true third major from *mi* to *ut*; afterwards, ſetting out from this *mi*, they tune the fifths *ſi*, *fa*※, *ut*※, *ſol*※, but flattening them ſtill leſs than the former, ſo that *ſol*※ may almoſt form a true third major with *mi*. When they have arrived at *ſol*※, they ſtop; they reſume the firſt *ut*, and tune to it the fifth *fa* in deſcending, then the fifth *ſi*♭, &c. and they heighten a little all the fifths till they have arrived at *la*♭, which ought to be the ſame with the *ſol*※ already tuned.

If, in the temperament commonly practiſed, ſome thirds are found to be leſs altered than in that preſcribed by M. Rameau, in return, the fifths in the firſt temperament are much more falſe, and many thirds are likewiſe ſo; inſomuch, that upon a harpſichord tuned according to the temperament in common uſe, there are five or ſix modes which the ear cannot endure, and in which it is impoſſible to execute any thing. On the contrary, in the temperament ſuggeſted by M. Rameau, all the modes are equally perfect; which is a new argument in its favour, ſince the temperament is peculiarly neceſſary in paſſing from one mode to another, without ſhocking the ear; for inſtance, from the mode of *ut* to that of *ſol*, from the mode of *ſol* to that of *re*, &c. It is true, that this uniformity of modulation will to the greateſt number of muſicians appear a defect: for they imagine, that, by tuning the ſemitones of the ſcale unequal, they give each of the modes a peculiar character; ſo that, according to them, the ſcale of *ut*,

ut, *re*, *mi*, *fa*, *ſol*, *la*, *ſi*, *UT*,

is not perfectly ſimilar to the gammut or diatonic ſcale of the mode of *mi*

mi, *fa*※, *ſol*※, *la*※, *ſi*, *ut*※, *re*※, *mi*,

which, in their judgment, renders the modes of *ut* and *mi* proper for different manners of expreſſion. But after all that we have ſaid in this treatiſe on the formation of diatonic intervals, every one ſhould be convinced, that, according to the intention of nature, the diatonic ſcale ought to be perfectly the ſame in all its modes: The contrary opinion, ſays M. Rameau, is a mere prejudice of muſicians. The character of an air ariſes chiefly from the intermixture of the modes; from the greater or leſſer degrees of vivacity in the movement; from the tones, more or leſs grave, or more or leſs acute, which are aſſigned to the generator of the mode; and from the chords more or leſs beautiful, as they are more or leſs deep, more or leſs flat, more or leſs ſharp, which are found in it.

In ſhort, the laſt advantage of this temperament is, that it will be found conformed, or at leaſt very little different from that which they practiſe upon inſtruments without keys; as the baſs-viol, the violin, in which true fifths and fourths are preferred to thirds and ſixths tuned with equal accuracy; a temperament which appears incompatible with that commonly uſed in tuning the harpſichord.

Yet we muſt not ſuffer our readers to be ignorant, that M. Rameau, in his *New Syſtem of Muſic*, printed in 1726, had adopted the ordinary temperament. In that work, (as may be ſeen CHAP. XXIV.), he pretends that the alteration of the fifths is much more ſupportable than that of the thirds major; and that this laſt interval can hardly ſuffer a greater alteration than the octave, which, as we know, cannot ſuffer the ſlighteſt alteration. He ſays, that if three ſtrings are tuned, one by an octave, the other by a fifth, and the next by a third major to a fourth ſtring, and if a ſound be produced from the laſt, the ſtrings tuned by a fifth will vibrate, though a little leſs true than it ought to have been; but that the octave and the third major, if altered in the leaſt degree, will not vibrate: and he adds, that the temperament which is now practiſed, is founded upon that principle. M. Rameau goes ſtill farther; and as, in the ordinary temperament, there is a neceſſity for altering the laſt thirds major, and to make them a little more ſharp, that they may naturally return to the octave of the principal ſound, he pretends that this alteration is tolerable, not only becauſe it is almoſt inſenſible, but becauſe it is found in modulations not much in uſe, unleſs the compoſer ſhould chooſe it on purpoſe to render the expreſſion ſtronger. "For it is proper to remark (ſays he), that we receive different impreſſions from the intervals in proportion to their different alterations: for inſtance, the third major, which naturally elevates us to joy, in proportion as we feel it, heightens our feelings even to a kind of fury, when it is tuned too ſharp; and the third minor, which naturally inſpires us with tenderneſs and ſerenity, depreſſes us to melancholy when it is too flat." All this ſtrain, as you may ſee, is immenſely different from that which this celebrated muſician afterwards

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By this method all the twelve ſounds which compoſe one of the ſcales ſhall be tuned: nothing is neceſſary but to tune with the greateſt poſſible exactneſs their octaves in the other ſcales, and the harpſichord ſhall be well tuned.

155 Alterations by either method hardly diſagreeable.

We have given this rule for temperament from M. Rameau; and it belongs only to diſintereſted artiſts to judge of it. However this queſtion be determined, and whatever kind of temperament may be received, the alterations which it produces in harmony will be but very ſmall, or not perceptible to the ear, whoſe attention is entirely engroſſed in attuning itſelf with the fundamental baſs, and which ſuffers, without uneaſineſs, theſe alterations, or rather takes no notice of them, becauſe it ſupplies from itſelf what may be wanting to the truth and perfection of the intervals.

Simple and daily experiments confirm what we now advance. Liſten to a voice which is accompanied, in ſinging, by different inſtruments; though the temperament of the voice, and the temperament of each of the inſtruments, are all different one from another, yet you will not be in the leaſt affected with the kind of cacophony which ought to reſult from theſe diverſities, becauſe the ear ſuppoſes theſe intervals true of which it does not appreciate differences.

We may give another experiment. Strike upon an organ the three keys *mi*, *ſol*, *ſi*, you will hear nothing but the minor perfect chord; though *mi*, by the conſtruction of that inſtrument, muſt cauſe *ſol*♯ likewiſe to be heard; though *ſol* ſhould have the ſame effect upon *re*, and *ſi* upon *fa*♯; inſomuch, that the ear is at once affected with all theſe ſounds, *re*, *mi*, *fa*♯, *ſol*, *ſol*♯, *ſi*: how many diſſonances perceived at the ſame time, and what a jarring multitude of diſcordant ſenſations, would reſult from thence to the ear, if the perfect chord with which it is preoccupied had not power entirely to abſtract its attention from ſuch ſounds as might offend!

Chap. VIII. *Of Repoſes or Cadences* (†).

156 Cadences perfect and imperfect, what and why.

73. In a fundamental baſs whoſe procedure is by fifths, there always is, or always may be, a *repoſe*, or criſis, in which the mind acquieſces in its tranſition from one ſound to another: but a repoſe may be more or leſs diſtinctly ſignified, and of conſequence more or leſs perfect. If one ſhould riſe by fifths; if, for inſtance, we paſs from *ut* to *ſol*; it is the generator which paſſes to one of theſe fifths, and this fifth was already pre-exiſtent in its generator: but the generator exiſts no longer in this fifth; and the ear, as this generator is the principle of all harmony and of all melody, feels a deſire to return to it. Thus the tranſition from a ſound to its fifth in aſcent, is termed an *imperfect repoſe*, or *imperfect cadence*; but the tranſition from any ſound to its fifth in deſcent, is denominated a *perfect cadence*, or an *abſolute repoſe*: it is the offspring which returns to its generator, and as it were recovers its exiſtence once more in that generator itſelf, with which when ſounding it reſounds (chap. i.)

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See *Repoſe* or *Cadence*.

157 Perfect cadences more or leſs perfect, and why.

74. Amongſt abſolute repoſes, there are ſome, if we may be allowed the expreſſion, more abſolute, that is to ſay, more perfect, than others. Thus in the fundamental baſs

ut, *ſol*, *ut*, *fa*, *ut*, *ſol*, *re*, *ſol*, *ut*,

which forms, as we have ſeen, the diatonic ſcale of the moderns, there is an abſolute repoſe from *re* to *ſol*, as from *ſol* to *ut*: yet this laſt abſolute repoſe is more perfect than the preceding, becauſe the ear, prepoſſeſſed with the mode of *ut* by the multiplied impreſſion of the ſound *ut* which it has already heard thrice before, feels a deſire to return to the generator *ut*; and it accordingly does ſo by the abſolute repoſe *ſol*, *ut*.

158 Cadence in melody different from what it is in harmony.

75. We may ſtill add, that what is commonly called *cadence* in melody, ought not to be confounded with what we name *cadence* in harmony.

In the firſt caſe, this word only ſignifies an agreeable and rapid alteration between two contiguous ſounds, called likewiſe a *trill* or *ſhake*; in the ſecond, it ſignifies a repoſe or cloſe. It is however true, that this ſhake implies, or at leaſt frequently enough preſages, a repoſe, either preſent or impending, in the fundamental baſs (x).

159 Cadences in the fundamental baſs neceſſary in the diatonic ſcale, and of which the moſt perfect.

76. Since there is a repoſe in paſſing from one ſound to another in the fundamental baſs, there is alſo a repoſe in paſſing from one note to another in the diatonic ſcale, which is formed from it, and which this baſs repreſents: and as the abſolute repoſe *ſol ut*, is

terwards exhibited in his *Generation Harmonique*, and in the performances which followed it. From this we can only conclude, that the reaſons which, after him, we have urged for the new temperament, muſt without doubt have appeared to him very ſtrong, becauſe in his mind they had ſuperſeded thoſe which he had formerly adduced in favour of the ordinary temperament.

We do not pretend to give any deciſion for either the one or the other of theſe methods of temperament, each of which appears to us to have its particular advantages. We ſhall only remark, that the choice of the one or the other muſt be left abſolutely to the taſte and inclination of the reader; without, however, admitting this choice to have any influence upon the principles of the ſyſtem of muſic, which we have followed even till this period, and which muſt always ſubſiſt, whatever temperament we adopt.

(†) That the reader may have a clear idea of the term before he enters upon the ſubject of this chapter, it may be neceſſary to caution him againſt a miſtake into which he may be too eaſily led by the ordinary ſignification of the word *repoſe*. In muſic, therefore, it is far from being ſynonymous with the word *reſt*. It is, on the contrary, the termination of a muſical *phraſe* which ends in a cadence more or leſs emphatic, as the ſentiment implied in the phraſe is more or leſs complete. Thus a repoſe in muſic anſwers the ſame purpoſe as punctuation in language. See Repos in Rouſſeau's Muſical Dictionary.

(x) M. Rouſſeau, in his letter on French muſic, has called this alternate undulation of different ſounds a *trill*, from the Italian word *trillo*, which ſignifies the ſame thing; and ſome French muſicians already appear to have adopted this expreſſion.

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of all others the moſt perfect in the fundamental baſs, the repoſe from *ſi* to *ut*, which anſwers to it in the ſcale, and which is likewiſe terminated by the generator, is for that reaſon the moſt perfect of all others in the diatonic ſcale aſcending.

160 Definition and uſe of a ſenſible note.

77. It is then a law dictated by nature itſelf, that if you would aſcend diatonically to the generator of a mode, you can only do this by means of the third major from the fifth of that very generator. This third major, which with the generator forms a ſemitone, has for that reaſon been called the *ſenſible note*, as introducing the generator, and preparing us for the moſt perfect repoſe.

See *Senſible Note.*

We have already proved, that the fundamental baſs is the principle of melody. We ſhall beſides make it appear in the ſequel, that the effect of a repoſe in melody ariſes ſolely from the fundamental baſs.

CHAP. IX. *Of the Minor Mode and its Diatonic Series.*

161 The diatonic ſeries of the minor mode aſcertained by different examples.

78. IN the ſecond chapter, we have explained (art. 29. 30. 31. and 32.) by what means, and upon what principle, the minor chord *ut*, *mi♭*, *ſol*, *ut*, may be formed, which is the characteriſtical chord of the minor mode. Now what we have there ſaid, taking *ut* for the principal and fundamental ſound, we might likewiſe have ſaid of any other note in the ſcale, aſſumed in the ſame manner as the principal and fundamental ſound: but as in the minor chord *ut*, *mi♭*, *ſol*, *ut*, there occurs a *mi♭* which is not found in the ordinary diatonic ſcale, we ſhall immediately ſubſtitute, for greater eaſe and conveniency, another chord, which is likewiſe minor and exactly ſimilar to the former, of which all the notes are found in the ſcale.

79. The ſcale affords us three chords of this kind, viz. *re*, *fa*, *la*, *re*; *la*, *ut*, *mi*, *la*; and *mi*, *ſol*, *ſi*, *mi*. Amongſt theſe three we ſhall chooſe *la*, *ut*, *mi*, *la*; becauſe this chord, without including any ſharp or flat, has two ſounds in common with the major chord *ut*, *mi*, *ſol*, *ut*; and beſides, one of theſe two ſounds is the very ſame *ut*: ſo that this chord appears to have the moſt immediate, and at the ſame time the moſt ſimple, relation with the chord *ut*, *mi*, *ſol*, *ut*. Concerning this we need only add, that this preference of the chord *la*, *ut*, *mi*, *la*, to every other minor chord, is by no means in itſelf neceſſary for what we have to ſay in this chapter upon the diatonic ſcale of the minor mode. We might in the ſame manner have choſen any other minor chord; and it is only, as we have ſaid, for greater eaſe and convenſency that we fix upon this.

162 Tonic or key in harmony, what.

80. Let us now remark, that in every mode, whether major or minor, the *principal* ſound which implies the perfect chord, whether major or minor, may be called the *tonic note* or *key*; thus *ut* is the key in its proper mode, *la* in the mode of *la*, &c. Having laid down this principle,

See *Principal.*

See *Tonic.*

163 The formation of the ſcale purſued.

81. We have ſhown how the three ſounds *fa*, *ut*, *ſol*, which conſtitute (art. 38.) the mode of *ut*, of which the firſt *fa* and the laſt *ſol* are the two-fifths of *ut*, one deſcending the other riſing, produce the ſcale *ſi*, *ut*, *re*, *mi*, *fa*, *ſol*, *la*, of the major mode, by means of the fundamental baſs *ſol*, *ut*, *ſol*, *ut*, *fa*, *ut*, *fa*: let us in the ſame manner take the three ſounds *re*, *la*, *mi*, which conſtitute the mode of *la*, for the ſame reaſon that the ſounds *fa*, *ut*, *ſol*, conſtitute the mode of *ut*; and of them let us form this fundamental baſs, perfectly like the preceding, *mi*, *la*, *mi*, *la*, *re*, *la*, *re*: let us afterwards place below each of theſe ſounds one of their harmonics, as we have done (chap. v.) for the firſt ſcale of the major mode; with this difference, that we muſt ſuppoſe *re* and *la* as implying their thirds minor in the fundamental baſs to characteriſe the minor mode; and we ſhall have the diatonic ſcale of that mode,

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See fig. G.

ſol♯, *la*, *ſi*, *ut*, *re*, *mi*, *fa*.

82. The *ſol*♯, which correſponds with *mi* in the fundamental baſs, forms a third major with that *mi*, though the mode be minor; for the ſame reaſon that a third from the fifth of the fundamental ſound ought to be major (art. 77.) when that third riſes to the fundamental ſound *la*.

See *Imply* or *Carry.*

83. It is true, that, in cauſing *mi* to imply its third major *ſol*, one might alſo riſe to *la* by a diatonic progreſs. But that manner of riſing to *la* would be leſs perfect than the preceding; for this reaſon (art. 76.), that the abſolute repoſe or perfect cadence, *mi*, *la*, which is found in the fundamental baſs, ought to be repreſented in the moſt perfect manner in the two notes of the diatonic ſcale which anſwer to it, eſpecially when one of theſe two notes is *la*, the key itſelf upon which the repoſe is made. From whence it follows, that the preceding note *ſol* ought rather to be ſharp than natural; becauſe *ſol*♯, being included in *mi* (art. 19.), much more perfectly repreſents the note *mi* in the baſs, than the natural *ſol* could do, which is not included in *mi*.

164 Diverſities in the ſcales of the major and minor mode.

84. We may remark this firſt difference between the ſcale

ſol♯, *la*, *ſi*, *ut*, *re*, *mi*, *fa*,

and the ſcale which correſponds with it in the major mode

ſi, *ut*, *re*, *mi*, *fa*, *ſol*, *la*,

that from *mi* to *fa*, which are the two laſt notes of the former ſcale, there is only a ſemitone; whereas from *ſol* to *la*, which are the two laſt ſounds of the latter ſeries, there is the interval of a complete tone: but this is not the only diſcrimination which may be found between the ſcales of the two modes.

165 Inveſtigation of theſe differences and their reaſons,

See fig. I.

85. To inveſtigate theſe differences, and to diſcover the reaſon for which they happen, we ſhall begin by forming a new diatonic ſcale of the minor mode, ſimilar to the ſecond ſcale of the major mode,

ut, *re*, *mi*, *fa*, *ſol*, *ſol*, *la*, *ſi*, *ut*.

That laſt ſeries, as we have ſeen, was formed by means of the fundamental baſs *fa*, *ut*, *ſol*, *re*, diſpoſed in this manner,

ut, *ſol*, *ut*, *fa*, *ut*, *ſol*, *re*, *ſol*, *ut*.

Let us take in the ſame manner the fundamental baſs *re la mi ſi*, and arrange it in the following order,

la, *mi*, *la*, *re*, *la*, *mi*, *ſi*, *mi*, *la*,

See fig. H.

and it will produce the ſcale immediately ſubjoined,

la, *ſi*, *ut*, *re*, *mi*, *mi*, *fa*♯, *ſol*♯, *la*,

in which *ut* forms a third minor with *la*, which in the fundamental baſs correſponds with it, which denominates the minor mode; and, on the contrary, *ſol*♯ forms a third major with *mi* in the fundamental baſs, becauſe *ſol*♯ riſes towards *la*, (art. 82. and 83.)

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86. We ſee beſides a *fa*※, which does not occur in the former,

ſol※, *la*, *ſi*, *ut*, *re*, *mi*, *fa*,

where *fa* is natural. It is becauſe, in the firſt ſcale, *fa* is a third minor from *re* in the baſs; and in the ſecond, *fa*※ is the fifth from *ſi* in the baſs.

166 Difference between the two ſcales of the minor mode greater than between thoſe of the major.

87. Thus the two ſcales of the minor mode are ſtill in this reſpect more different one from the other than the two ſcales of the major mode; for we do not remark this difference of a ſemitone between the two ſcales of the major mode. We have only obſerved (art. 63.) ſome difference in the value of *la* as it ſtands in each of theſe ſcales, but this amounts to much leſs than a ſemitone.

167 *Fa* and *ſol* ſharp in the minor mode, and why.

88. From thence it may be ſeen why *fa* and *ſol* are ſharp when aſcending in the minor mode; nay, beſides, the *fa* is only natural in the firſt ſcale *ſol*※, *la*, *ſi*, *ut*, *re*, *mi*, *fa*, becauſe this *fa* cannot riſe to *ſol*※, (art. 48.)

168 The caſe different in deſcending, and why.

89. It is not the ſame caſe in deſcending. For *mi*, the fifth of the generator, ought not to imply the third major *ſol*※, but in the caſe when that *mi* deſcends to the generator *la* to form a perfect repoſe (art. 77. and 83.); and in this caſe the third major *ſol*※ riſes to the generator *la*: but the fundamental baſs *la mi* may, in deſcending, give the ſcale *la ſol* natural, provided *ſol* does not riſe towards *la*.

169 Explication of the deſcending ſcale in the minor mode from a fundamental baſs difficult.

90. It is much more difficult to explain how the *fa*, which ought to follow this *ſol* in deſcending, is natural and not ſharp; for the fundamental baſs

la, *mi*, *ſi*, *mi*, *la*, *re*, *la*, *mi*, *la*,

produces in deſcending,

la, *ſol*, *fa*※, *mi*, *mi*, *re*, *ut*, *ſi*, *la*.

And it is plain that the *fa* cannot be otherwiſe than ſharp, ſince *fa*※ is the fifth of the note *ſi* of the fundamental baſs. In the mean time, experience evinces that the *fa* is natural in deſcending in the diatonic ſcale of the major mode of *la*, eſpecially when the preceding *ſol* is natural: and it muſt be acknowledged, that here the fundamental baſs appears in ſome meaſure defective.

170 Rameau's ſolution, though the only one, yet unſatisfactory.

M. Rameau has invented the following means for obtaining a ſolution of this difficulty. According to him, in the diatonic ſcale of the minor mode in deſcending, *la*, *ſol*, *fa*, *mi*, *re*, *ut*, *ſi*, *la*, *ſol*, may be regarded ſimply as a note of paſſage, merely added to give ſweetneſs to the modulation, and as a diatonic gradation by which we may deſcend to *fa* natural. It is eaſily perceived, according to M. Rameau, by this fandametal baſs,

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la, *re*, *la*, *re*, *la*, *mi*, *la*,

which produces

la, *fa*, *mi*, *re*, *ut*, *ſi*, *la*;

which may be regarded, as he ſays, as the real ſcale of the minor mode in deſcending; to which is added *ſol* natural between *la* and *fa*, to preſerve the diatonic order.

This anſwer appears the only one which can be given to the difficulty above propoſed: but I know not whether it will fully ſatisfy the reader; whether he will not ſee with regret, that the fundamental baſs does not produce, to ſpeak properly, the diatonic ſcale of the minor mode in deſcent, when at the ſame time this ſame baſs ſo happily produces the diatonic ſcale of that identical mode in aſcending, and the diatonic ſcale of the major mode whether in riſing or deſcending (Y).

CHAP. X. *Of Relative Modes.*

171 Modes relative, what. See *Mode.*

91. Two modes which are of ſuch a nature that we can paſs from the one to the other, are called *relative modes*. Thus we have already ſeen, that the major mode of *ut* is relative to the major mode of *fa* and to that of *ſol*. It may likewiſe appear from what goes before, how many intimate connections there are between the *ſpecies* (†) or major mode of *ut*, and the *ſpecies* or minor mode of *la*. For, 1. The perfect chords, one major *ut mi ſol ut*, the other minor *la ut mi la*, which characteriſe each of thoſe two kinds of modulation* or harmony, have two ſounds in common, *ut* or *mi*. 2. The diatonic ſcale of the minor mode of *la* in deſcent, abſolutely contains the ſame ſounds with the gammut or diatonic ſcale of the major mode of *ut*. * See *Modulation.*

It is for this reaſon that the tranſition is ſo natural and eaſy from the major mode of *ut* to the minor mode of *la*, or from the minor mode of *la* to the major mode of *ut*, as experience proves.

92. In the minor mode of *mi*, the minor perfect chord *mi ſol ſi mi*, which characteriſes it, has likewiſe two ſounds, *mi*, *ſol*, in common with the perfect chord major *ut mi ſol ut*, which characteriſes the major mode of *ut*. But the minor mode of *mi* is not ſo cloſely related nor allied to the major mode of *ut* as to the minor mode of *la*; becauſe the diatonic ſcale of the minor mode of *mi* in deſcent, has not, like the ſeries of the

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(Y) For what remains, when *ſol* is ſaid to be natural in deſcending the diatonic ſcale of the minor mode of *la*, this only ſignifies, that this *ſol* is not neceſſarily ſharp in deſcending as it is in riſing; for this *ſol*, beſides, may be ſharp in deſcending to the minor mode of *la*, as may be proved by numberleſs examples, of which all muſical compoſitions are full. It is true, that when the ſound *ſol* is found ſharp in deſcending to the minor mode of *la*, ſtill we are not ſure that the mode is minor till the *fa* or *ut* natural is found; both of which impreſs a peculiar character on the minor mode, viz. *ut* natural, in riſing and in deſcending, and the *fa* natural in deſcending.

(†) *Species* was the only word which occurred to the tranſlator in Engliſh by which he could render the French word *genre*. It is, according to Rouſſeau, intended to expreſs the different diviſions and diſpoſitions of the intervals which formed the two tetrachords in the ancient diatonic ſcale; and as the gammut of the moderns conſiſts likewiſe of two tetrachords, though diverſified from the former, as our author has ſhown at large, the *genre* or *ſpecies*, as the tranſlator has been obliged to expreſs it, muſt conſiſt in the various diſpoſitions and diviſions of the different intervals between the notes or ſemitones which compoſe the modern ſcale.

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the minor mode of *la*, all these sounds in common with the scale of *ut*. In reality, this scale is *mi re ut si la sol fa*♯ *mi*, where there occurs a *fa* sharp which is not in the scale of *ut*. We may add, that though the minor mode of *mi* is less relative to the major mode of *ut* than that of *la*; yet the artist does not hesitate sometimes to pass immediately from the one to the other.

Of this may be seen one instance (among many others) in the prologue *des Amours des Dieux*, at this passage, *Ovide est l'objet de la fete*, which is in the minor mode of *mi*, though what immediately precedes it is in the major mode of *ut*.

We may see besides, that when we pass from one mode to another by the interval of a third, whether in descending or rising, as from *ut* to *la*, or from *la* to *ut*, from *ut* to *mi*, or from *mi* to *ut*, the major mode becomes minor, or the minor mode becomes major.

93. There is still another minor mode, into which an immediate transition may be made in issuing from the major mode of *ut*. It is the minor mode of *ut* itself in which the perfect minor chord *ut mi*♭ *sol ut* has two sounds, *ut* and *sol*, in common with the perfect major chord *ut mi sol ut*. Nor is there any thing more common than a transition from the major mode of *ut* to the minor mode, or from the minor to the major(z).

Chap. XI. *Of Dissonance.*

172 Cases in which the mode is uncertain.

94. We have already observed, that the mode of *ut* (*fa*, *ut*, *sol*), has two sounds in common with the mode of *sol* (*ut*, *sol*, *re*); and two sounds in common with the mode of *fa* (*si*♭, *fa*, *ut*); of consequence, this procedure of the bass *ut sol* may belong to the mode of *ut*, or to the mode of *sol*, as the procedure of the bass *fa ut*, or *ut fa*, may belong to the mode of *ut* or the mode of *fa*. When any one therefore passes from *ut* to *fa* or to *sol* in a fundamental bass, he is still ignorant even to that crisis what mode he is in. It would be, however, advantageous to know it, and to be able by some means to distinguish the generator from its fifths.

173 How we may investigate the generator and its fifths, and by that means determine the mode.

95. This advantage may be obtained by uniting at the same time the sounds *sol* and *fa* in the same harmony, that is to say, by joining to the harmony *sol si re* of the fifth *sol*, the other fifth *fa* in this manner, *sol*, *si*, *re*, *fa*; this *fa* which is added, forms a dissonance with *sol* (art. 18.) It is for that reason that the chord *sol si re fa*, is called a *dissonant* chord, or a chord of the seventh. It serves to distinguish the fifth *sol* from the generator *ut*, which always implies, without mixture or alteration, the perfect chord *ut*, *mi*, *sol*, *ut*, resulting from nature itself (art. 32.) By this we may see, that when we pass from *ut* to *sol*, one passes at the same time from *ut* to *fa*, because *fa* is found to be comprehended in the chord of *sol*; and the mode of *ut* by these means plainly appears to be determined, because there is none but that mode to which the sounds *fa* and *sol* at once belong.

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174 Manner of treating dissonances continued.

96. Let us now see what may be added to the harmony *fa*, *la*, *ut*, of the fifth *fa* below the generator, to distinguish this harmony from that of the generator. It seems probable at first, that we should add to it the other fifth *sol*, so that the generator *ut*, in passing to *fa*, may at the same time pass to *sol*, and that by this the mode should be determined: but this introduction of *sol*, in the chord *fa*, *la*, *ut*, would produce two seconds in succession *fa*, *sol*, *sol*, *la*, that is to say, two dissonances whose union would prove extremely harsh to the ear; an inconvenience which ought carefully to be avoided. For if, to distinguish the mode, we should alter the harmony of the fifth *fa* in the fundamental bass, it must only be altered in the least degree possible.

175 Chord of the great sixth.

97. For this reason, instead of *sol*, we shall take its fifth *re*, which is the sound that approaches it the nearest; and we shall have, instead of the fifth *fa*, the chord *fa*, *la*, *ut*, *re*, which is called a *chord of the great sixth*.

One may here remark the analogy there is observed between the harmony of the fifth *sol* and that of the fifth *fa*.

176 The subject of dissonances continued.

98. The fifth *sol*, in rising above the generator, gives a chord entirely consisting of thirds ascending from *sol*, *sol*, *si*, *re fa*; now the fifth *fa* being below the generator *ut* in descending, we shall find, as we go lower by thirds from *ut* towards *fa*, the same sounds *ut*, *la*, *fa*, *re*, which form the chord *fa*, *la*, *ut*, *re*, given to the fifth *fa*.

99. It appears besides, that the alteration of the harmony in the two fifths consists only in the third minor *re*, *fa*, which was reciprocally added to the harmony of these two fifths.

Chap. XII. *Of the Double Use or Employment of Dissonance.*

177 Account of the double employment.

100. It is evident by the resemblance of sounds to their octaves, that the chord *fa*, *la*, *ut*, *re*, is in effect the same as the chord *re*, *fa*, *la*, *ut*, taken inversely *, that the inverse of the chord *ut*, *la*, *fa*, *re*, has been found

* See Inverted.

(z) There are likewise other minor modes, into which we may pass in our egress from the mode major of *ut*; as that of *fa* minor, in which the perfect minor chord *fa*, *la*♭, *ut*, includes the sound *ut*, and whose scale in ascent *fa*, *sol*, *la*♭, *si*♭, *ut*, *re*, *mi*, *fa*, only includes the two sounds *la*♭, *si*♭, which do not occur in the scale of *ut*. We find an example of this transition from the mode major of *ut* to that of *fa* minor, in the opera of *Pygmalion* by M. Rameau, where the *sarabando* is in the minor mode of *fa*, and the *rigadoon* in the mode major of *ut*. This kind of transition, however, is not frequent.

The minor mode of *re* has only in its scale ascending *re*, *mi*, *fa*, *sol*, *la*, *si*, *ut*♯, *re*, one *ut* sharp which is not found in the scale of *ut*. For this reason a transition may likewise be made, without grating the ear, from the mode of *ut* major to the mode of *re* minor; but this passage is less immediate than the former, because the chords *ut*, *mi*, *sol*, *ut*, *re*, *fa*, *la*, *re*, not having a single sound in common, one cannot (art. 37.) pass immediately from the one to the other.

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found (art. 98.) in descending by thirds from the generator *ut* (AA).

178 Difference between dominant and tonic dominant.

101. The chord *re, fa, la, ut*, is a chord of the seventh like the chord *sol, si, re fa:* with this only difference, that in this the third *sol, si*, is major: whereas in the second, the third *re, fa*, is minor. If the *fa* were sharp, the chord *re, fa*♯, *la, ut*, would be a genuine chord of the dominant, like the chord *sol, si, re, fa;* and as the dominant *sol* may descend to *ut* in the fundamental bass, the dominant *re* implying or carrying with it the third major *fa*♯ might in the same manner descend to *sol.*

102. Now I say, that if the *fa*♯ should be changed into *fa* natural, *re*, the fundamental tone of this chord *re, fa, la, ut*, might still descend to *sol;* for the change from *fa*♯ to *fa* natural, will have no other effect, than to preserve the impression of the mode of *ut*, instead of that of the mode of *sol*, which the *fa*♯ would have here introduced. For what remains, the note *re* will always preserve its character as the dominant, on account of the mode of *ut*, which forms a seventh. Thus in the chord of which we treat, *re, fa, la, ut, re*, may be considered as an *imperfect dominant:* I call it *imperfect*, because it carries with it the third minor *fa*, instead of the third major *fa*♯. It is for this reason that in the sequel I shall call it simply the *dominant*, to distinguish it from the dominant *sol*, which shall be named the *tonic dominant* †.

See *Dominant.*

103. Thus the sounds *fa* and *sol*, which cannot succeed each other (art. 36.) in a diatonic bass, when they only carry with them the perfect chords *fa, la, ut, sol, si, re*, may succeed one another if you join *re* to the harmony of the first, and *fa* to the harmony of the second; and if you invert the first chord, that is to say, if you give to the two chords this form, *re, fa, la, ut, sol, si, re, fa.*

179 Seeming contradictions reconciled.

104. Besides, the chord *fa, la, ut, re*, being allowed to succeed the perfect chord *ut, mi, sol, ut*, it follows for the same reasons, that the chord *ut, mi, sol, ut*, may be succeeded by *re, fa, la, ut;* which is not contradictory to what we have above said (art. 37.), that the sounds *ut* and *re* cannot succeed one another in the fundamental bass: for in the passage quoted, we had supposed that both *ut* and *re* carried with them a perfect chord major; wherens, in the present case, *re* carries the third minor *fa*, and likewise the sound *ut*, by which the chord *re fa la ut* is connected with that which precedes it *ut mi sol ut;* and in which the sound *ut* is found. Besides, this chord, *re fa la ut*, is properly nothing else but the chord *fa la ut re* inverted, and, if we may speak so, disguised.

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180 Double employment, what, and why so called.

105. This manner of presenting the chord of the sub-dominant under two different forms, and of employing it under these two different forms, has been called by M. Rameau its *double office* or *employment* †. This is the source of one of the finest varieties in harmony; and we shall see in the following chapter the advantages which result from it.

† See *Double employment.*

We may add, that as this double employment is a kind of licence, it ought not to be practised without some precaution. We have lately seen that the chord *re fa la ut*, considered as the inverse of *fa la ut re*, may succeed to *ut mi sol ut*, but this liberty is not reciprocal: and though the chord *fa la ut re* may be followed by the chord *ut mi sol ut*, we have no right to conclude from thence that the chord *re fa la ut*, considered as the inverse of *fa la ut re*, may be followed by the chord *ut mi sol ut.* For this the reason shall be given

CHAP. XVI.

CHAP. XIII. *Concerning the Use of this Double Employment, and its Rules.*

181 By the double use of the abovementioned chord, the impression of the mode may be preserved.

106. We have shown (chap. vi.) how the diatonic scale, or ordinary gammut, may be formed from the fundamental bass *fa, ut, sol, re*, by twice repeating the word *sol* in that series; so that this gammut is primitively and originally composed of two similar tetrachords, one in the mode of *ut*, the other in that of *sol.* Now it is possible, by means of this double employment, to preserve the impression of the mode of *ut* through the whole extent of the scale, without twice repeating the note *sol*, or even without supposing this repetition. For this effect we have nothing to do but form the following fundamental bass,

ut, sol, ut, fa, ut, re, sol, ut:

in which *ut* is understood to carry with it the perfect chord *ut mi sol ut; sol*, the chord *sol si re fa; fa*, the chord

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(AA) "M. Rameau, in several passages of his works (for instance, in p. 110, 111, 112, and 113, of the *Generation Harmonique)*, appears to consider the chord *re, fa, la, ut*, as the primary chord and generator of the chord *fa, la, ut, re*, which is nothing but that chord itself reversed; in other passages (particularly in p. 116. of the same performance), he seems to consider the first of these chords as nothing else but the reverse of the second. It would seem that this great artist has neither expressed himself upon this subject with so much uniformity nor with so much precision as is required. For my own part, I think there is some foundation for considering the chord *fa, la, ut, re*, as primitive: 1. Because in this chord, the fundamental and principal note is the sub-dominant *fa*, which ought in effect to be the fundamental and principal sound in the chord of the sub-dominant. 2. Because that without having recourse, with M. Rameau, to harmonical and arithmetical progressions, of which the consideration appears to us quite foreign to the question, we have found a probable and even a satisfactory reason for adding the note *re* to the harmony of the fifth *fa* (art. 96. and 97.) The origin thus assigned for the chord of the sub-dominant appears to us the most natural, though M. Rameau does not appear to have felt its full value; for scarcely has it been slightly insinuated by him."

Thus far our author. We do not enter with him into the controversy concerning the origin of the chord in question; but only propose to add to his definition of the sub-dominant Rousseau's idea of the same note. It is a name, says he, given by M. Rameau to the fourth note in any modulation relative to a given key, which of consequence is in the same interval from the key in descending as the dominant in rising; from which circumstance it takes its name.

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chord *fa la ut re*; and *re*, the chord *re fa la ut*. It is plain from what has been ſaid in the preceding chapter, that in this caſe *ut* may aſcend to *re* in the fundamental baſs, and *re* deſcend to *ſol*, and that the impreſſion of the mode of *ut* is preſerved by the *fa* natural, which forms the third minor *re fa*, inſtead of the third major which *re* ought naturally to imply.

107. This fundamental baſs will give, as it is evident, the ordinary diatonic ſcale,

ut, re, mi, fa, ſol, la, ſi, UT,

which of conſequence will be in the mode of *ut* alone; and if one ſhould chooſe to have the ſecond tetrachord in the mode of *ſol*, it will be neceſſary to ſubſtitute *fa*♯ inſtead of *fa* natural in the harmony of *re* (BB).

108. Thus the generator *ut* may be followed according to pleaſure in aſcending diatonically either by a tonic dominant (*re fa*♯ *la ut*), or by a ſimple dominant (*re fa la ut*).

109. In the minor mode of *la*, the tonic dominant *mi* ought always to imply its third major *mi ſol*♯, when this dominant *mi* deſcends to the generator *la* (art. 83.); and the chord of this dominant ſhall be *mi ſol*♯ *ſi re*, entirely ſimilar to *ſol ſi re fa*. With reſpect to the ſub-dominant *re*, it will immediately imply the third minor *fa*, to denominate the minor mode; and we may add *ſi* above its chord *re fa la*, in this manner *re fa la ſi*, a chord ſimilar to that of *fa la ut re*; and as we have deduced from the chord *fa la ut re* that of *re fa la ut*, we may in the ſame manner deduce from the chord *re fa la ſi* a new chord of the ſeventh *ſi re fa la*, which will exhibit the *double employment of diſſonances* in the minor mode.

110. One may employ this chord *ſi re fa la*, to preſerve the impreſſion of the mode of *la* in the diatonic ſcale of the minor mode, and to prevent the neceſſity of twice repeating the ſound *mi*; but in this caſe, the *fa* muſt be rendered ſharp, and change this chord to *ſi re fa*♯ *la*, the fifth of *ſi* is *fa*♯, as we have ſeen above; this chord is then the inverſe of *re fa*♯ *la ſi*, where the ſubdominant implies the third major, which ought not to ſurpriſe us. For in the minor mode of *la*, the ſecond tetrachord *mi fa*♯ *ſol*♯ *la* is exactly the ſame as it would be in the major mode of *la*; now, in the major mode of *la*, the ſub-dominant *re* ought to imply the third major *fa*♯.

182 Diverſities in the minor mode more numerous than in the major.

111. From thence we may ſee that the minor mode is ſuſceptible of a much greater number of varieties than the major: likewiſe the major mode is the product of nature alone; whereas the minor is, in ſome meaſure, the product of art. But in return, the major mode has received from nature, to which it owes its immediate formation, a force and energy which the minor cannot boaſt.

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CHAP. XIV. *Of the Different Kinds of Chords of the Seventh.*

183 Inveſtigation whether art, in conſequence of ſome ſucceſsful advances, may not be carried farther.

112. THE diſſonance added to the chord of the dominant and of the ſub-dominant, though in ſome meaſure inſinuated by nature (chap. xi.), is nevertheleſs a work of art; but as it produces great beauties in harmony by the variety which it introduces into it, let us diſcover whether, in conſequence of this firſt advance, art may not ſtill be carried farther.

184 Different chords of the ſeventh.

113. We have already three different kinds of chords of the ſeventh, *viz.*

1. The chord *ſol ſi re fa*, compoſed of a third major followed by two thirds minor.

2. The chord *re fa la ut*, or *ſi re fa*♯ *la*, compoſed of a third major between two minors.

3. The chord *ſi re fa la*, compoſed of two thirds minor followed by a major.

114. There are ſtill two other kinds of chords of the ſeventh which are employed in harmony; one is compoſed of a third minor between two thirds major, *ut mi ſol ſi*, or *fa la ut mi*; the other is wholly compoſed of thirds minor *ſol*♯ *ſi re fa*. Theſe two chords, which at firſt appear as if they ought not to enter into harmony if we rigorouſly keep to the preceding rules, are nevertheleſs frequently practiſed with ſucceſs in the fundamental baſs. The reaſon is this:

185 The chords laſt deſcribed admiſſible, and why.

115. According to what has been ſaid above, if we would add a ſeventh to the chord *ut mi ſol*, to make a dominant of *ut*, one can add nothing but *ſi*♭; and in this caſe *ut mi ſol ſi*♭ would be the chord of the tonic dominant in the mode of *fa*, as *ſol ſi re fa* is the chord of the tonic dominant in the mode of *ut*; but if you would preſerve the impreſſion of the mode of *ut* in the harmony, you then change this *ſi*♭ into *ſi* natural, and the chord *ut mi ſol ſi*♭ becomes *ut mi ſol ſi*. It is the ſame caſe with the chord *fa la ut mi*, which is nothing elſe but the chord *fa la ut mi*♭; in which one may ſubſtitute for *mi*♭, *mi* natural, to preſerve the impreſſion of the mode of *ut*, or of that of *fa*.

Beſides, in ſuch chords as *ut mi ſol ſi*, *fa la ut mi*, the ſounds *ſi* and *mi*, though they form a diſſonance with

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(BB) We need only add, that it is eaſy to ſee, that this fundamental baſs *ut ſol, ut fa, ut re, ſol ut*, which formed the aſcending ſcale *ut, re, mi, fa, ſol, la, ſi, UT*, cannot by inverting it, and taking it inverſely in this manner *ſi, ut, ſol, re, ut, fa, ut, ſol, UT*, form the diatonic ſcale *UT, ſi, la, ſol, fa, mi, re, ut*, in deſcent. In reality, from the chord *ſol, ſi, re, fa*, we cannot paſs to the chord *re, fa, la, ut*, nor from thence to *ut, mi, ſol, ut*. It is for this reaſon that in order to have the fundamental baſs of the ſcale, *UT, ſi, la, ſol, fa, mi, re, ut*, in deſcent, we muſt either determine to invert the fundamental baſs mentioned in art. 55. in this manner, *ut, ſol, re, ſol, ut, fa, ut, ſol, ut*, in which the ſecond *ſol* and the ſecond *ut* anſwer to the *ſol* alone in the ſcale; or otherwiſe we muſt form the fundamental baſs *ut, ſol, re, ſol, ut, ſol, ut*, in which all the notes imply perfect chords major, except the ſecond *ſol*, which implies the chord of the ſeventh *ſol, ſi, re, fa*, and which anſwers to the two notes of the ſcale *ſol, fa*, both comprehended in the chord *ſol, ſi, re, fa*.

Whichever of theſe two baſſes we ſhall chooſe, it is obvious that neither the one nor the other ſhall be wholly in the mode of *ut*, but in the mode of *ut* and in that of *ſol*. From whence it follows, that the double employment which gives to the ſcale a fundamental baſs all in the ſame mode when aſcending, cannot do the ſame in deſcending; and that the fundamental baſs of the ſcale in deſcending will be neceſſarily in two different modes.

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with *ut* in the firſt caſe, and with *fa* in the ſecond, are nevertheleſs ſupportable to the ear, becauſe theſe ſounds *ſi* and *mi* (art. 19.) are already contained and underſtood, the firſt in the note *mi* of the chord *ut mi ſol ſi*, as likewiſe in the note *ſol* of the ſame chord; the ſecond in the note *la* of the chord *fa la ut mi*, as likewiſe in the note *ut* of the ſame chord. All together then ſeem to allow the artiſt to introduce the note *ſi* and *mi* into theſe two chords (cc).

186 Chords of the ſeventh continued and explained.

116. With reſpect to the chord of the ſeventh *ſol♯ ſi re fa*, wholely compoſed of thirds minor, it may be regarded as formed from the union of the two chords of the dominant and of the ſub-dominant in the minor mode. In effect, in the minor mode of *la*, for inſtance, theſe two chords are *mi ſol♯ ſi re*, and *re fa la ſi*, whoſe union produces *mi, ſol♯, ſi, re, fa, la*. Now, if we ſhould ſuffer this chord to remain thus, it would be diſagreeable to the ear, by its multiplicity of diſſonances, *re mi*, *mi la*, *la ſol♯*, *la ſi*, *re ſol♯*, (art. 18.); ſo that, to avoid this inconveniency, the generator *la* is immediately expunged, which (art. 19.) is as it were underſtood in *re*, and the fifth or dominant *mi* whoſe place the ſenſible note *ſol♯* is ſuppoſed to hold: thus there remains no more than the chord *ſol♯ ſi re fa*, wholly compoſed of thirds minor, and in which the dominant *mi* is conſidered as underſtood; in ſuch a manner that the chord *ſol♯ ſi re fa* repreſents the chord of the tonic dominant *mi ſol♯ ſi re*, to which we have joined the chord of the ſub-dominant *re fa la ſi*, but in which the dominant *mi* is always reckoned the principal note (DD).

117. Since, then, from the chord *mi ſol♯ ſi re*, we may paſs to the perfect *la ut mi la*, and *vice verſa*, we may in like manner paſs from the chord *ſol♯ ſi re fa* to the chord *la ut mi la*, and from this laſt to the chord *ſol♯ ſi re fa*: this remark will be very uſeful to us in the ſequel.

CHAP. XV. *Of the Preparation of Diſcords.*

187 Diſſonance, what.

118. In every chord of the ſeventh, the higheſt note, that is to ſay, the ſeventh above the fundamental, is called a *diſſonance* or *diſcord*; thus *fa* is the diſſonance of the chord *ſol ſi re fa*, *ut* in the chord *re fa la ut*, &c.

188 Manner of preparing diſſonances inveſtigated.

119. When the chord *ſol ſi re fa* follows the chord *ut mi ſol ut*, as this may happen, and in reality often happens, it is obvious that we do not find the diſſonance *fa* in the preceding chord *ut mi ſol ut*. Nor ought it indeed to be found in that chord; for this diſſonance is nothing elſe but the ſub-dominant added to the harmony of the dominant to determine the mode: now, the ſub-dominant is not found in the harmony of the generator.

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120. For the ſame reaſon, when the chord of the ſub-dominant *fa la ut re* follows the chord *ut mi ſol ut*, the note *re*, which forms a diſſonance with *ut*, is not found in the preceding chord.

It is not ſo when the chord *re fa la ut* follows the chord *ut mi ſol ut*; for *ut*, which forms a diſſonance in the ſecond chord, ſtands as a conſonance in the preceding.

189 Diſſonance is only tolerable to the ear when found in preceding chords.

121. In general, diſſonance being the production of art (chap. xi.), eſpecially in ſuch chords as are not of the tonic dominant nor ſub-dominant; the only means to prevent its diſpleaſing the ear by appearing too heterogeneous to the chord, is, that it may be, if we may ſpeak ſo, announced to the ear by being found in the preceding chord, and by that means ſerve to connect the two chords. From whence follows this rule:

190 Preparation of diſſonances how performed.

122. In every chord of the ſeventh, which is not the chord of the tonic dominant, that is to ſay, (art. 102.) which is not compoſed of a third major followed by two thirds minor, the diſſonance which this chord forms ought to ſtand as a conſonance in the chord which precedes it.

This is what we call a *prepared diſſonance*. See *Preparation*.

123. From thence it follows, that in order to prepare a diſſonance, it is abſolutely neceſſary that the fundamental baſs ſhould aſcend by the interval of a ſecond, as

UT mi ſol ut, RE fa la ut;

or deſcend by a third, as

UT mi ſol ut, LA ut mi ſol;

or deſcend by a fifth, as

UT mi ſol ut, FA la ut mi:

in every other caſe the diſſonance cannot be prepared. This is what may be eaſily aſcertained. If, for inſtance, the fundamental baſs riſes by a third, as *ut mi ſol ut, mi ſol ſi re*, the diſſonance *re* is not found in the chord *ut mi ſol ut*. The ſame might be ſaid of *ut mi ſol ut, ſol ſi re fa*, and *ut mi ſol ut, ſi re fa la*, in which the fundamental baſs riſes by a fifth or deſcends by a ſecond.

124. It may only be added, that when a tonic, that is to ſay, a note which carries with it a perfect chord, is followed by a dominant in the interval of a fifth or third, this procedure may be regarded as a proceſs from that ſame tonic to another, which has been

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(cc) On the contrary, a chord ſuch as *ut mi♭ ſol ſi*, in which *mi* would be flat, could not be admitted in harmony, becauſe in this chord the *ſi* is not included and underſtood in *mi♭*. It is the ſame caſe with ſeveral other chords, ſuch as *ſi re fa la♯*, *ſi re♯ fa la*, &c. It is true, that in the laſt of theſe chords, *la* is included in *fa*, but it is not contained in *re♯*; and this *re♯* likewiſe forms with *fa* and with *la* a double diſſonance, which, joined with the diſſonance *ſi fa*, would neceſſarily render this chord not very pleaſing to the ear; we ſhall yet, however, ſee in the ſecond part, that this chord is ſometimes uſed.

(DD) We have ſeen (art. 109.) that the chord *ſi re fa la*, in the minor mode of *la*, may be regarded as the inverſe of the chord *re fa la ſi*; it would likewiſe ſeem, that, in certain caſes, this chord *ſi re fa la* may be conſidered as compoſed of the two chords *ſol ſi re fa*, *fa la ut re*, of the dominant and of the ſub-dominant of the major mode of *ut*; which chords may be joined together, after having excluded from them, 1. The dominant *ſol*, repreſented by its third major *ſi*, which is preſumed to retain its place. 2. The note *ut* which is underſtood in *fa*, which will form this chord *ſi re fa la*. The chord *ſi re fa la*, conſidered in this point of view, may be underſtood as belonging to the major mode of *ut* upon certain occaſions.

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been rendered a dominant by the addition of the diſſonance.

Moreover, we have ſeen (art. 119. and 120.) that a diſſonance does not ſtand in need of preparation in the chords of the tonic dominant and of the ſub-dominant: from whence it follows, that every tonic carrying with it a perfect chord, may be changed into a tonic dominant (if the perfect chord be major), or into a ſubdominant (whether the chord be major or minor) by adding the diſſonance all at once.

Chap. XVI. *Of the Rules for* reſolving *Diſſonances.*

191 Diſſonances to be reſolved, muſt be diſguiſed and made to appear in the character of harmonics.

125. We have ſeen (chap. v. and vi.) how the diatonic ſcale, ſo natural to the voice, is formed by the harmonies of fundamental ſounds; from whence it follows, that the moſt natural ſucceſſion of harmonical ſounds is to be diatonic. To give a diſſonance then, in ſome meaſure, as much the character of an harmonic ſound as may be poſſible, it is neceſſary that this diſſonance, in that part of the modulation where it is found, ſhould deſcend or riſe diatonically upon another note, which may be one of the conſonances of the ſubſequent chord.

192 In the chord of the tonic dominant, the diſſonance ſhould rather riſe than deſcend, and why.

126. Now in the chord of the tonic dominant it ought rather to deſcend than to riſe; for this reaſon. Let us take, for inſtance, the chord *ſol ſi re fa* followed by the chord *ut mi ſol ut*; the part which formed the diſſonance *fa* ought to deſcend to *mi* rather than riſe to *ſol*, though both the ſounds *mi* and *ſol* are found in the ſubſequent chord *ut mi ſol ut*; becauſe it is more natural and more conformed to the connection which ought to be found in every part of the muſic, that *ſol* ſhould be found in the ſame part where *ſol* has already been ſounded, whilſt the other part was ſounding *fa*, as may be here ſeen (parts firſt and fourth.)

Firſt part, - -	*fa mi*,
Second, - - -	*ſi ut*,
Third, - - - -	*re ut*,
Fourth, - - -	*ſol ſol*,
Fundamental baſs, - -	*ſol ut*.

193 Conſequences of the former rule.

127. For the ſame reaſon, in the chord of the ſimple dominant *re fa la ut*, followed by *ſol ſi re fa*, diſſonance *ut* ought rather to deſcend to *ſi* than riſe to *re*.

194 Another conſonance

128. In ſhort, for the ſame reaſon, we ſhall find, that in the chord of the ſub-dominant *fa la ut re*, the diſſonance *re* ought to riſe to *mi* of the following chord *ut mi ſol ut*, rather than deſcend to *ut*; whence may be deduced the following rules.

195 But is deduced from the former propoſitions.

129. 1°. In every chord of the dominant, whether tonic or ſimple, the note which conſtitutes the ſeventh, that is to ſay the diſſonance, ought diatonically to deſcend upon one of the notes which form a conſonance in the ſubſequent chord.

2°. In every chord of the ſubdominant, the diſſonance ought to riſe diatonically upon the third of the ſubſequent chord.

196 Diſſonance reſolved, what. See *Reſolution.*

130. A diſſonance which deſcends or riſes diatonically according to theſe two rules, is called a *diſſonance reſolved.*

From theſe rules it is a neceſſary reſult, that the chord of the ſeventh *re fa la ut*, though one ſhould even conſider it as the inverſe of *fa la ut re*, cannot be ſucceeded by the chord *ut mi ſol ut*, ſince there is not in this laſt chord of *ſi* any note upon which the diſſonance *ut* of the chord *re fa la ut* can deſcend.

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One may beſides find another reaſon for this rule, in examining the nature of the double employment of diſſonances. In effect, in order to paſs from *re fa la ut*, to *ut mi ſol ut*, it is neceſſary that *re fa la ut* ſhould in this caſe be underſtood as the inverſe of *fa la ut re*. Now the chord *re fa la ut* can only be conceived as the inverſe of *fa la ut re*, when this chord *re fa la ut* precedes or immediately follows the *ut mi ſol ut*; in every other caſe the chord *re fa la ut* is a primitive chord, formed from the perfect minor chord *re fa la*, to which the diſſonance *ut* was added, to take from *re* the character of a tonic. Thus the chord *re fa la ut*, could not be followed by the chord *ut mi ſol ut*, but after having been preceded by the ſame chord. Now, in this caſe, the *double employment* would be entirely a futile expedient, without producing any agreeable effect; becauſe, inſtead of this ſucceſſion of chords, *ut mi ſol ut*, *re fa la ut*, *ut mi ſol ut*, it would be much more eaſy and natural to ſubſtitute this other, which furniſhes this natural proceſs, *ut mi ſol ut*, *fa la ut re*, *ut mi ſol ut*. The proper uſe of the double employment is, that, by means of inverting the chord of the ſub-dominant, it may be able to paſs from that chord thus inverted to any other chord except that of the tonic, to which it naturally leads.

Chap. XVII. *Of the Broken or Interrupted Cadence.*

197 The teſt of perfection in cadences, to be found in the fundamental baſs.

131. In a fundamental baſs which moves by fifths, there is always, as we have formerly obſerved (chap. viii.), a repoſe more or leſs perfect from one ſound to another; and of conſequence there muſt likewiſe be a repoſe more or leſs perfect from one ſound to another in the diatonic ſcale, which reſults from that baſs. It may be demonſtrated by a very ſimple experiment, that the cauſe of a repoſe in melody is ſolely in the fundamental baſs expreſſed or underſtood. Let any perſon ſing theſe three notes *ut re ut*, performing on the *re* a ſhake, which is commonly called a *cadence*; the modulation will appear to him to be finiſhed after the ſecond *ut*, in ſuch a manner that the ear will neither expect nor wiſh any thing to follow. The caſe will be the ſame if we accompany this modulation with its natural fundamental baſs *ut ſol ut*: but if, inſtead of this baſs, we ſhould give it the following, *ut ſol la*; in this caſe the modulation *ut re ut* would not appear to be finiſhed, and the ear would ſtill expect and deſire ſomething more. This experiment may eaſily be made.

198 Broken cadences what, and why. See *Cadence.*

132. This paſſage *ſol la*, when the dominant *ſol* diatonically aſcends upon the note *la*, inſtead of deſcending by a fifth upon the generator *ut*, as it ought naturally to do, is called a *broken cadence*; becauſe the perfect cadence *ſol ut*, which the ear expected after the dominant *ſol*, is, if we may ſpeak ſo, broken and ſuſpended by the tranſition from *ſol* to *la*.

133. From thence it follows, that if the modulation *ut re ut* appeared finiſhed when we ſuppoſed no baſs to it at all, it is becauſe its natural fundamental baſs *ut ſol ut* is ſuppoſed to be implied; becauſe the ear deſires ſomething to follow this modulation, as ſoon as it is reduced to the neceſſity of hearing another baſs.

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134. The interrupted cadence may, as it ſeems to me, be conſidered as having its origin in the *double employment of diſſonances*; ſince this cadence, like the double employment, only conſiſts in a diatonic procedure of the baſs aſcending (chap. xii.) In effect, nothing hinders us to deſcend from the chord *ſol ſi re fa* to the chord *ut mi ſol la*, by converting the tonic *ut* into a ſub-dominant, that is to ſay, by paſſing all at once from the mode of *ut* to the mode of *ſol*: now to deſcend from *ſol ſi re fa* to *ut mi ſol la* is the ſame thing as to riſe from the chord *ſol ſi re fa* to the chord *la ut mi ſol*, in changing the chord of the ſubdominant *ut mi ſol la* for the imperfect chord of the dominant, according to the laws of the double employment.

199 Origin of interrupted cadence in the double employment of diſſonances.

135. In this kind of cadence, the diſſonance of the firſt chord is reſolved by deſcending diatonically upon the fifth of the ſubſequent chord. For inſtance, in the broken cadence *ſol ſi re fa, la ut mi ſol*, the diſſonance *fa* is reſolved by deſcending diatonically upon the fifth *mi*.

200 Manner of performing this cadence.

136. There is ſtill another kind of cadence called an *interrupted cadence*, where the dominant deſcends by a third to another dominant, inſtead of deſcending by a fifth upon the tonic, as in this proceſs of the baſs, *ſol ſi re fa, mi ſol ſi re*; in the caſe of an interrupted cadence, the diſſonance of the former chord is reſolved by deſcending diatonically upon the octave of the fundamental note of the ſubſequent chord, as may be here ſeen, where *fa* is reſolved upon the octave of *mi*.

201 Interrupted cadence, what. See *Cadence*.

137. This kind of interrupted cadence, as it ſeems to me, has likewiſe its origin in the double employment of diſſonances. For let us ſuppoſe theſe two chords in ſucceſſion, *ſol ſi re fa, ſol ſi re mi*, where the note *ſol* is ſucceſſively a tonic dominant and ſub-dominant; that is to ſay, in which we paſs from the mode of *ut* to the mode of *re*; if we ſhould change the ſecond of theſe chords into the chord of the dominant, according to the laws of the double employment, we ſhall have the interrupted cadence *ſol ſi re fa, mi ſol ſi re*.

202 Origin of this kind of cadence, likewiſe in the double employment.

CHAP. XVIII. *Of the Chromatic Species.*

203 Fundamental baſs may be formed by thirds major.

138. THE ſeries or fundamental baſs by fifths produces the diatonic ſpecies in common uſe (chap. vi.): now the third major being one of the harmonics of a fundamental ſound as well as the fifth, it follows, that we may form fundamental baſſes by thirds major, as we have already formed fundamental baſſes by fifths.

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139. If then we ſhould form this baſs *ut, mi, ſol*♯, the two firſt ſounds carrying each along with it their thirds major and fifths, it is evident that *ut* will give *ſol*, and that *mi* will give *ſol*♯: now the ſemitone which is between this *ſol* and this *ſol*♯ is an interval much leſs than the ſemitone which is found in the diatonic ſcale between *mi* and *fa*, or between *ſi* and *ut*. This may be aſcertained by calculation (EE): it is for this reaſon that the ſemitone from *mi* to *fa* is called *major*, and the other *minor* (FF).

204 A chromatic interval or minor ſemitone, how found. See *fig.* K.

140. If the fundamental baſs ſhould proceed by thirds minor in this manner, *ut, mi*♭, a ſucceſſion which is allowed when we have inveſtigated the origin of the minor mode (chap. ix.), we ſhall find this modulation *ſol, ſol*♭, which would likewiſe give a minor ſemitone (GG).

205 An intonation minor ſemitone difficult to be hit, and why.

141. The minor ſemitone is hit by young practitioners in intonation with more difficulty than the ſemitone major. For which this reaſon may be aſſigned: The ſemitone major which is found in the diatonic ſcale, as from *mi* to *fa*, reſults from a fundamental baſs by fifths *ut fa*, that is to ſay, by a ſucceſſion which is moſt natural, and for this reaſon the eaſieſt to the ear. On the contrary, the minor ſemitone ariſes from a ſucceſſion by thirds, which is ſtill leſs natural than the former. Hence, that ſcholars may truly hit the minor ſemitone, the following artifice is employed. Let us ſuppoſe, for inſtance, that they intend to riſe from *ſol* to *ſol*♯; they riſe at firſt from *ſol* to *la*, then deſcend from *la* to *ſol*♯ by the interval of a ſemitone major; for this *ſol* ſharp, which is a ſemitone major below *la*, proves a ſemitone minor above *ſol*. [See the notes (EE) and (FF).]

206 Minor ſemitone to be found in every procedure of the fundamental baſs by thirds.

142. Every procedure of the fundamental baſs by thirds, whether major or minor, riſing or deſcending, gives the minor ſemitone. This we have already ſeen from the ſucceſſion of thirds in aſcending. The ſeries of thirds minor in deſcending, *ut, la*, gives *ut, ut*♯ (HH);

(EE) In reality, *ut* being ſuppoſed 1, as we have always ſuppoſed it, *mi* is $\frac{4}{5}$, and *ſol*♯ $\frac{25}{16}$: now *ſol* being $\frac{3}{2}$, *ſol*♯ then ſhall be to *ſol* as $\frac{25}{16}$ to $\frac{3}{2}$; that is to ſay, as 25 times 2 to 3 times 16: the proportion then of *ſol*♯ to *ſol* is as 25 to 24, an interval much leſs than that of 16 to 15, which conſtitutes the ſemitone from *ut* to *ſi*, or from *fa* to *mi* (note L.)

(FF) It may be obſerved, that a minor joined to a major ſemitone will form a minor tone; that is to ſay, if one riſes, for inſtance, from *mi* to *fa*, by the interval of a ſemitone major, and afterwards from *fa* to *fa*♯ by the interval of a minor ſemitone, the interval from *mi* to *fa*♯ will be a minor tone. For let us ſuppoſe *mi* to be 1, *fa* will be $\frac{16}{15}$, and *fa*♯ will be $\frac{25}{24}$ of $\frac{16}{15}$; that is to ſay, 25 times 16 divided by 24 times 15, or $\frac{10}{9}$; *mi* then is to *fa*♯ as 1 is to $\frac{10}{9}$, the interval which conſtitutes the minor tone (note N.)

With reſpect to the tone major, it cannot be exactly formed by two ſemitones; for, 1. Two major ſemitones in immediate ſucceſſion would produce more than a tone major. In effect, $\frac{16}{15}$ multiplied by $\frac{16}{15}$ gives $\frac{256}{225}$, which is greater than $\frac{9}{8}$, the interval which conſtitutes (note N) the major tone. 2. A ſemitone minor and a ſemitone major would give leſs than a major tone, ſince they amount only to a true minor. 3. And, *à fortiori*, two minor ſemitones would give ſtill leſs.

(GG) In effect, *mi*♭ being $\frac{6}{5}$, *ſol*♭ will be $\frac{6}{5}$ of $\frac{6}{5}$; that is to ſay, (note C) $\frac{36}{25}$: now the proportion of $\frac{1}{2}$ to $\frac{36}{25}$ (note C) is that of 3 times 25 to 2 times 36; that is to ſay, as 25 to 24.

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(HH); and the ſeries of thirds major in deſcending, *ut*, *lab*, gives *ut*, *utb*, (11).

207 The minor ſemitone when prevalent, conſtitutes chromatic muſic.

143. The minor ſemitone conſtitutes the ſpecies called *chromatic*; and with the ſpecies which moves by diatonic intervals, reſulting from the ſucceſſion of fifths (chap. v. and vi.), it comprehends the whole of melody.

CHAP. XIX. *Of the Enharmonic Species.*

208 Dièſis or enharmonic interval, what, and how formed.

144. THE two extremes, or higheſt and loweſt notes, *ut ſol*♯, of the fundamental baſs by thirds major, *ut mi ſol*♯, give this modulation *ut fi*♯; and theſe two ſounds *ut*, *fi*♯, differ between themſelves by a ſmall interval which is called the *dièſis*, or *enharmonic fourth* of a tone* (LL), which is the difference between a ſemitone major and a ſemitone minor (MM). This quarter tone is inappretiable by the ear, and impracticable upon ſeveral of our inſtruments. Yet have means been found to put it in practice in the following manner, or rather to perform what will have the ſame effect upon the ear.

* See *Fourth of a Tone.*

209 Manner of ſeemingly introducing this interval upon inſtruments of fixed ſcales.

145. We have explained (art. 116.) in what manner the chord *ſol*♯ *fi re fa* may be introduced into the minor mode, entirely conſiſting of thirds minor perfectly true, or at leaſt ſuppoſed ſuch. This chord ſupplying the place of the cord of the dominant (art. 116.) from thence we may paſs to that of the tonic or generator *la* (art. 117.). But we muſt remark,

1. That this chord *ſol*♯ *fi re fa*, entirely conſiſting of thirds minor, may be inverted or modified according to the three following arrangements, *fi re fa ſol*♯, *re fa ſol*♯ *fi*, *fa ſol*♯ *fi re*; and that in all theſe three different ſtates, it will ſtill remain compoſed of thirds minor; or at leaſt there will only be wanting the enharmonic fourth of a tone to render the third minor between *fa* and *ſol*♯ entirely juſt; for a true third minor, as that from *mi* to *ſol* in the diatonic ſcale, is compoſed of a ſemitone and a tone both major. Now from *fa* to *ſol* there is a tone major, and from *ſol* to *ſol*♯ there is only a minor ſemitone. There is then awanting (art. 144.) the enharmonic fourth of a tone, to render the third *fa ſol*♯ exactly true.

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2. But as this diviſion of a tone cannot be found in the gradations of any ſcale practicable upon moſt of our inſtruments, nor be appretiated by the ear, the ear takes the different chords,

ſi	*re*	*fa*	*ſol*♯
re	*fa*	*ſol*♯	*ſi*,
fa	*ſol*♯	*ſi*	*re*,

which are abſolutely the ſame, for chords compoſed every one of thirds minor exactly juſt.

Now the chord *ſol*♯ *ſi re fa*, belonging to the minor mode of *la*, where *ſol*♯ is the ſenſible note; the chord *ſi re fa ſol*♯, or *ſi re fa lab*, will, for the ſame reaſon, belong to the minor mode of *ut*, where *ſi* is the ſenſible note. In like manner, the chord *re fa ſol*♯ *ſi*, or *ſi re fa lab utb*, will belong to the minor mode of *mib*, and the chord *fa ſol*♯ *ſi re*, or *fa lab utb mibb*, to the minor mode of *ſolb*.

After having paſſed then by the mode of *la* to the chord *ſol*♯ *ſi re fa* (art. 117.), one may by means of this laſt chord, and by merely ſatisfying ourſelves to invert it, afterwards paſs all at once to the modes of *ut* minor, of *mib* minor, or of *ſolb* minor; that is to ſay, into the modes which have nothing, or almoſt nothing,

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(HH) *La* being $\frac{5}{6}$, *ut*♯ is $\frac{5}{4}$ of $\frac{5}{6}$; that is to ſay $\frac{25}{24}$, and *ut* is 1: the proportion then between *ut* and *ut*♯ is that of 1 to $\frac{25}{24}$, or of 24 to 25.

(II) *Lab* being the third major below *ut*, will be $\frac{4}{5}$ (note c): *utb*, then, is $\frac{7}{5}$ of $\frac{4}{5}$; that is to ſay $\frac{28}{25}$. The proportion, then, between *ut* and *utb*, is as 25 to 24.

(LL) *Sol*♯ being $\frac{25}{16}$ and *fi*♯ being $\frac{5}{4}$ of $\frac{25}{16}$, we ſhall have *fi*♯ equal (note c) to $\frac{125}{64}$, and its octave below ſhall be $\frac{125}{128}$; an interval leſs than unity by about $\frac{3}{128}$ or $\frac{1}{41}$. It is plain then from this fraction, that the *fi*♯ in queſtion muſt be conſiderably lower than *ut*.

This interval has been called *the fourth of a tone*, and this denomination is founded on reaſon. In effect, we may diſtinguiſh in muſic four kinds of quarter tones.

1. The fourth of a tone major: now, a tone major being $\frac{9}{8}$, and its difference from unity being $\frac{1}{8}$, the difference of this quarter tone from unity will be almoſt the fourth of $\frac{1}{8}$; that is to ſay, $\frac{1}{32}$.

2. The fourth of a tone minor; and as a tone minor, which is $\frac{10}{9}$, differs from unity by $\frac{1}{9}$, the fourth of a minor tone will differ from unity about $\frac{1}{36}$.

3. One half of a tone major; and as this ſemitone differs from unity by $\frac{1}{15}$, one half of it will differ from unity about $\frac{1}{30}$.

4. Finally, one half of a ſemitone minor, which differs from unity by $\frac{1}{24}$: its half then will be $\frac{1}{48}$.

The interval, then, which forms the enharmonic fourth of a tone, as it does not differ from unity but by $\frac{1}{41}$, may juſtly be called the *fourth of a tone*, ſince it is leſs different from unity than the largeſt interval of a quarter tone, and more than the leaſt.

We ſhall add, that ſince the enharmonic fourth of a tone is the difference between a ſemitone major and a ſemitone minor; and ſince the tone minor is formed (note FF) of two ſemitones, one major and the other minor; it follows, that two ſemitones major in ſucceſſion form an interval larger than that of a tone by the enharmonic fourth of a tone; and that two minor ſemitones in ſucceſſion form an interval leſs than a tone by the ſame fourth of a tone.

(MM) That is to ſay, that if you riſe from *mi* to *fa*, for inſtance, by the interval of a ſemitone major, and afterwards, returning to *mi*, you ſhould riſe by the interval of a ſemitone minor to another ſound which is not in the ſcale, and which I ſhall mark thus, *fa*+, the two ſounds *fa*+ and *fa* will form the enharmonic fourth of a tone: for *mi* being 1, *fa* will be $\frac{16}{15}$; and *fa*+ $\frac{25}{24}$: the proportion then between *fa*+ and *fa* is that of $\frac{25}{24}$ to $\frac{16}{15}$ (note c); that is to ſay, as 25 times 15 to 16 times 24; or otherwiſe, as 25 times 5 to 16 times 8, or as 125 to 128. Now this proportion is the ſame which is found, in the beginning of the preceding note, to expreſs the enharmonic fourth of a tone.

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nothing, in common with the minor mode of *la*, and which are entirely foreign to it (†).

210 The alteration, how ever, by which it is effectuated, abrupt and ſenſible.

146. It muſt, however, be acknowledged, that a tranſition ſo abrupt, and ſo little expected, cannot deceive nor elude the ear; it is ſtruck with a ſenſation ſo unlooked-for without being able to account for the paſſage to itſelf. And this account has its foundation in the enharmonic fourth of a tone; which is overlooked as nothing, becauſe it is inappretiable by the ear; but of which, though its value is not aſcertained, the whole harſhneſs is ſenſibly perceived. The inſtant of ſurpriſe, however, immediately vaniſhes; and that aſtoniſhment is turned into admiration, when one feels himſelf tranſported as it were all at once, and almoſt imperceptibly, from one mode to another, which is by no means relative to it, and to which he never could have immediately paſſed by the ordinary ſeries of fundamental notes.

Chap. XX. *Of the Diatonic Enharmonic Species.*

147. If we form a fundamental baſs, which riſes alternately by fifths and thirds, as *fa*, *ut*, *mi*, *ſi*, this baſs will give the following modulation, *fa*, *mi*, *mi*, *re*♯; in which the ſemitones from *fa* to *mi*, and from *mi* to *re*♯, are equal and major (nn).

See fig. M.

e Enharonic.

This ſpecies of modulation or of harmony, in which all the ſemitones are major, is called the *enharmonic diatonical* ſpecies. The major ſemitones peculiar to this ſpecies give it the name of *diatonic*, becauſe major ſemitones belong to the diatonic ſpecies; and the tones which are greater than major by the exceſs of a fourth, reſulting from a ſucceſſion of major ſemitones, give it the name of *enharmonic* (note ll).

Chap. XXI. *Of the Chromatic Enharmonic Species.*

211 Chromatic enharmonic intervals, how formed. *See fig.* N.

148. If we paſs alternately from a third minor in deſcending to a third major in riſing, as *ut*, *ut*, *la*, *ut*♯, *ut*♯, we ſhall form this modulation *mi*♭, *mi*, *mi*, *mi*, *mi*♯, in which all the ſemitones are minor (oo).

This ſpecies is called the *chromatic enharmonical* ſpecies: the minor ſemitones peculiar to this kind give it the name of *chromatic*, becauſe minor ſemitones belong to the chromatic ſpecies; and the ſemitones which are leſſer by the diminution of a fourth reſulting from a ſucceſſion of minor ſemitones, give it the name of *enharmonic* (note ll).

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212 From this ſpecies, the effects of harmony and melody appear to be in the fundamental baſs.

149. Theſe new ſpecies confirm what we have all along ſaid, that the whole effects of harmony and melody reſide in the fundamental baſs.

213 Diatonic ſpecies moſt agreeable, and why.

150. The diatonic ſpecies is the moſt agreeable, becauſe the fundamental baſs which produces it is formed from a ſucceſſion of fifths alone, which is the moſt natural of all others.

214 The chromatic next.

151. The chromatic being formed from a ſucceſſion of thirds, is the moſt natural after the preceding.

215 Laſtly, the enharmonic.

152. Finally, the enharmonic is the leaſt agreeable of all, becauſe the fundamental baſs which gives it is not immediately indicated by nature. The fourth of a tone which conſtitutes this ſpecies, and which is itſelf inappretiable to the ear, neither produces nor can produce its effect, but in proportion as imagination ſuggeſts the fundamental baſs from whence it reſults; a baſs whoſe procedure is not agreeable to nature, ſince it is formed of two ſounds which are not contiguous one to the other in the ſeries of thirds (art. 144.)

Chap. XXII. *Showing that Melody is the Offſpring of Harmony.*

216 The effects of melody to be inveſtigated in harmony expreſſed or underſtood.

153. All that we have hitherto ſaid, as it ſeems to me, is more than ſufficient to convince us, that melody has its original principle in harmony; and that it is in harmony, expreſſed or underſtood, that we ought to look for the effects of melody.

154. If this ſhould ſtill appear doubtful, nothing more is neceſſary than to pay due attention to the firſt experiment (art. 19.), where it may be ſeen that the principal ſound is always the loweſt, and that the ſharper ſounds which it generates are with relation to it what the treble of an air is to its baſs.

155. Yet more, we have proved, in treating of broken cadence (chap. xvii.), that the diverſification of baſſes

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(†) As this method for obtaining or ſupplying enharmonic gradations cannot be practiſed on every occaſion when the compoſer or practitioner would wiſh to find them, eſpecially upon inſtruments where the ſcale is fixed and invariable, except by a total alteration of their œconomy, and re-tuning the ſtrings, Dr Smith in his Harmonics has propoſed an expedient for redreſſing or qualifying this defect, by the addition of a greater number of keys or ſtrings, which may divide the tone or ſemitone into as many appretiable or ſenſible intervals as may be neceſſary. For this, as well as for the other advantageous improvements which he propoſes in the ſtructure of inſtruments, we cannot with too much warmth recommend the peruſal of his learned and ingenious book to ſuch of our readers as aſpire to the character of genuine adepts in the theory of muſic.

(nn) It is obvious, that if *fa* in the baſs be ſuppoſed 1, *fa* of the ſcale will be 2, *ut* of the baſs $\frac{1}{2}$, and *mi* of the ſcale $\frac{5}{4}$ of $\frac{1}{2}$, that is, $\frac{15}{8}$; the proportion of *fa* to *mi* is as 2 to $\frac{15}{8}$, or as 1 to $\frac{15}{16}$. Now *mi* of the baſs being likewiſe $\frac{5}{4}$ of $\frac{1}{1}$, or $\frac{15}{8}$; *ſi* of the baſs is $\frac{1}{2}$ of $\frac{15}{8}$, and its third major *re*♯ $\frac{5}{4}$ of $\frac{1}{2}$ of $\frac{15}{8}$, or $\frac{15}{8}$ of $\frac{15}{8}$; this third major, approximated as much as poſſible to *mi* in the ſcale by means of octaves, will be $\frac{15}{16}$ of $\frac{15}{8}$; *mi* then of the ſcale will be to *re*♯ which follows it, as $\frac{15}{8}$ is to $\frac{15}{16}$ of $\frac{15}{8}$, that is to ſay, as 1 to $\frac{15}{16}$. The ſemitones then from *fa* to *mi*, and from *mi* to *re*♯, are both major.

(oo) It is evident that *mi*♭ is $\frac{6}{5}$ (note c), and that *mi* is $\frac{5}{4}$: theſe two *mi*'s, then, are between themſelves as $\frac{6}{5}$ to $\frac{5}{4}$, that is to ſay, as 6 times 4 to 5 times 5, or as 24 to 25, the interval which conſtitutes the minor ſemitone. Moreover, the *la* of the baſs is $\frac{5}{6}$, and *ut*♯ $\frac{5}{4}$ of $\frac{5}{6}$, or $\frac{25}{24}$: *mi*♯ then is $\frac{5}{4}$ of $\frac{25}{24}$, the *mi* in the ſcale is likewiſe to the *mi*♯ which follows it, as 24 to 25. All the ſemitones therefore in this ſcale are minor.

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baſſes produces effects totally different in a modulation which, in other reſpects, remains the ſame.

156. Can it be ſtill neceſſary to adduce more convincing proofs? We have nothing to do but examine the different baſſes which may be given to this very ſimple modulation *ſol, ut;* of which it will be found ſuſceptible of a great many, and each of theſe baſſes will give a different character to the modulation *ſol ut*, though in itſelf it remains always the ſame; in ſuch a manner that we may change the whole nature and effects of a modulation, without any other alteration except that of changing its fundamental baſs.

M. Rameau has ſhown, in his *New Syſtem of Muſic*, printed at Paris 1726, p. 44. that this modulation *ſol ut*, is ſuſceptible of 20 different fundamental baſſes. Now the ſame fundamental baſs, as may be ſeen in our ſecond part, will afford ſeveral continued or thorough baſſes. How many means, of conſequence, may be practiſed to vary the expreſſion of the ſame modulation?

217 Conſequences deducible from this principle.

157. From theſe different obſervations it may be concluded, 1. That an agreeable melody, naturally implies a baſs extremely ſweet and adapted for ſinging; and that reciprocally, as muſicians expreſs it, a baſs of this kind generally prognoſticates an agreeable melody (PP).

2. That the character of a juſt harmony is only to form in ſome meaſure one ſyſtem with the modulation, ſo that from the whole taken together the ear may only receive, if we may ſpeak ſo, one ſimple and indiviſible impreſſion. Theory of Harmony.

3. That the character of the ſame modulation may be diverſified, according to the character of the baſs which is joined with it.

But notwithſtanding the dependency of melody upon harmony, and the ſenſible influence which the latter may exert upon the former; we muſt not however from thence conclude, with ſome celebrated muſicians, that the effects of harmony are preferable to thoſe of melody. Experience proves the contrary. [See, on this account, what is written on the licence of muſic, printed in tom. iv. of D'Alembert's *Melanges de Literature*, p. 448.]

General Remark.

The diatonic ſcale or gammut being compoſed of twelve ſemitones, it is clear that each of theſe ſemitones taken by itſelf may be the generator of a mode; and that thus there muſt be twenty-four modes in all, twelve major and twelve minor. We have aſſumed the major mode of *ut*, to repreſent all the major modes in general, and the minor mode of *la* to repreſent the modes minor, to avoid the difficulties ariſing from ſharps and flats, of which we muſt have encountered either a greater or leſſer number in the other modes. But the rules we have given for each mode are general, whatever note of the gammut be taken for the generator of a mode.

Part II. Principles and Rules of COMPOSITION.

218 Compoſition in harmony, what. See *Compoſition.*

158. Composition, which is likewiſe called *counterpoint*, is not only the art of compoſing an agreeable air, but alſo that of compoſing a great many airs in ſuch a manner that when heard at the ſame time, they may unite in producing an effect agreeable and delightful to the ear; this is what we call *compoſing muſic in ſeveral parts.*

The higheſt of theſe parts is called the *treble*, the loweſt is termed the *baſs;* the other parts, when there are any, are termed *middle parts;* and each in particular is ſignified by a different name.

Chap. I. *Of the Different Names given to the ſame Interval.*

219 Particular intervals ſignified by different names, and why.

159. In the introduction (art. 9.), which is at the front of this treatiſe, we have ſeen a detail of the moſt common names which are given to the different intervals. But there are particular intervals which have obtained different names, according to particular circumſtances; which it is proper to explain.

220 Second redundant, what.

160. An interval compoſed of a tone and a ſemitone, which is commonly called a *third minor*, is likewiſe ſometimes called a *ſecond redundant;* ſuch is the interval from *ut* to *re*♯ in aſcending, or that of *la* to *ſol*♭ deſcending.

221 Why ſo called.

This interval is ſo termed, becauſe one of the ſounds which form it is always either ſharp or flat, and that, if you deduce that ſharp or that flat, the interval will be that of a ſecond.

222 Falſe fifth, what.

161. An interval compoſed of two tones and two ſemitones, as that from *ſi* to *fa*, is called a *falſe fifth.* This interval is the ſame with the *triton* (art. 9.), ſince two tones and two ſemitones are equivalent to three tones. There are, however, ſome reaſons for diſtinguiſhing them, as will appear below.

223 Fifth redundant, what.

162. As the interval from *ut* to *re*♯ in aſcending has been called a ſecond redundant, they likewiſe call the interval from *ut* to *ſol*♯ in aſcending a *fifth redundant*, or from *ſi* to *mi*♭ in deſcending, each of which intervals are compoſed of four tones.

224 Diſtinguiſhed from the ſixth minor.

This interval is, in the main, the ſame with that of the ſixth minor (art. 6.): but in the fifth redundant there is always a ſharp or a flat; inſomuch, that if this ſharp or flat were deduced, the interval would become a true fifth.

225 Seventh diminiſhed, what.

163. For the ſame reaſon, an interval compoſed of three tones and three ſemitones, as from *ſol*♯ to *fa* in aſcending,

(PP) There are likewiſe ſeveral eminent muſicians, who in their compoſitions, if we can depend on what has been affirmed, begin with determining and writing the baſs. This method, however, appears in general more proper to produce a learned and harmonious muſic, than a ſtrain prompted by genius and animated by enthuſiaſm.

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ascending, is called a *seventh diminished;* because, if you deduce the sharp from *sol*, the interval from *sol* to *fa* will become that of an ordinary seventh. The interval of a seventh diminished is in other respects the same with that of the sixth major (art. 9.)

226 Seventh major and redundant coincident.

164. The major seventh is likewise sometimes called a *seventh redundant* (QQ.)

Chap. II. *Comparison of the Different Intervals.*

227 Notes in different octaves or scales replications each of the other.

165. If we sing *ut si* in descending by a second, and afterwards *ut si* in ascending by a seventh, these two *si*'s shall be octaves one to the other; or, as we commonly express it, they will be *replications* one of the other.

166. On account then of the resemblance between every sound and its octave (art. 22.), it follows, that *to rise by a seventh*, or *descend by a second*, amount to one and the same thing.

167. In like manner, it is evident that the sixth is nothing but a replication of the third, nor the fourth but a replication of the fifth.

168. The following expressions either are or ought to be regarded as synonymous.

228 Hence to descend to one replication, and rise to another, has the same effect.

229 Detail of replications.

230 Examples of this.

To rise	by a second.	To descend	by a seventh.
To descend		To rise	
To rise	by a third.	To descend	by a sixth.
To descend		To rise	
To rise	by a fourth.	To descend	by a fifth.
To descend		To rise	

169. Thus, therefore, we shall employ them indifferently the one for the other; so that when we say, for instance, *to rise by a third*, it may be said with equal propriety *to descend by a sixth*, &c.

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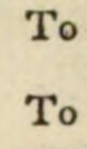
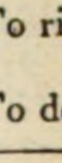
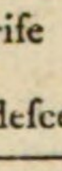
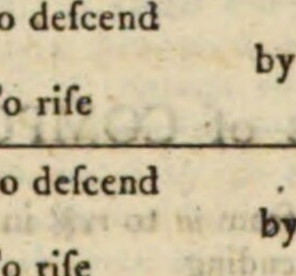
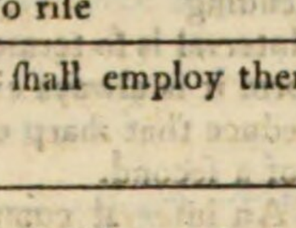
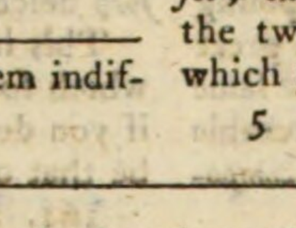
Chap. III. *Of the different Cleffs; of the Value or Quantity; of the Rithmus; and of Syncopation.*

170. There are three cleffs * in music; the cleff of *fa* , or  ; the cleff *ut*  ; and the cleff of *sol*  . But, in Britain, the following characters are used: The F, or bass-cleff  ; the C, or tenor cleff  ; and the G, or treble cleff  .

* See *Cleff.*

231 Cleffs, what,

232 And how placed. *See fig.* O.

The cleff of *fa* is placed on the fourth line, or on the third; and the line upon which this cleff is placed gives the name of *fa* or *F*, to all the notes which are upon that line.

See fig. P.

The cleff of *ut* is placed upon the fourth, the third, the second, or the first line; and in these different positions all the notes upon that line where the cleff is placed take the name of *ut*, or *C*.

See fig. Q.

Lastly, the cleff of *sol* is placed upon the second or first line; and all the notes upon that line where the cleff is placed take the name of *sol*, or *G*.

233 Names of notes to be investigated from the position of the cleffs. *See fig.* Q.

171. As the notes are placed on the lines, and in the spaces between the lines, any one, when he sees the cleff, may easily find the name of any note whatever. Thus he may see, that, in the first cleff of *fa*, the note which is placed on the lowest line ought to be *sol*; that the note which occupies the space between the two first lines should be *la*; and that the note which is on the second line is a *si*, &c. (RR).

(QQ) The chief use of these different denominations is to distinguish chords: for instance, the chord of the redundant fifth and that of the diminished seventh are different from the chord of the sixth; the chord of the seventh redundant, from that of the seventh major. This will be explained in the following chapters.

(RR) It is on account of the different compasses of voices and instruments that these cleffs have been invented.

The masculine voice, which is the lowest, may at its greatest depth, without straining, descend to *sol*, which is in the last line of the first cleff of *fa*; and the female voice, which is the sharpest, may at its highest pitch rise to a *sol*, which is a triple octave above the former.

The lowest of masculine voices is adapted to a part which may be called a *mean bass*, and its cleff is that of *fa* on the fourth line; this cleff is likewise that of the violoncello and of the deepest instruments. A mean bass extremely deep is called a *baritonus* or *counter-bass*.

The masculine voice which is next in depth to what we have called the *mean bass* may be termed the *concordant bass*. Its cleff is that of *fa* on the third line.

The masculine voice which follows the *concordant bass* may be denominated a *tenor*; a voice of this pitch is the most common, yet seldom extremely agreeable. Its cleff is that of *ut* on the fourth line. This cleff is also that of the bassoon or bass-hautboy.

The highest masculine voice of all may be called *counter tenor*. Its cleff is that of *ut* on the third line. It is likewise the cleff of tenor violins, &c.

The deepest female voice immediately follows the counter tenor, and may be called *bass in alt*. Its cleff is that of *ut* upon the first line. The cleff of *ut* upon the second line is not in frequent use.

The sharpest female voice is called *treble*; its cleff is that of *sol* on the second line.

This last cleff, as well as that of *sol* on the first line, is likewise the cleff of the sharpest instruments, such as the violin, the flute, the trumpet, the hautboy, the flagelet, &c.

The *ut* which may be seen in the cleffs of *fa* and in the cleffs of *ut* is a fifth above the *fa* which is on the line of the cleff of *fa*; and the *sol* which is on the two cleffs of *sol* is a fifth above *ut*: insomuch that *sol* which

is

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234 Marks and powers of ſharps, flats, and naturals, what.

172. A note before which there is a ſharp (marked thus ♯) ought to be raiſed by a ſemitone; and if, on the contrary, there is a ♭ before it, it ought to be depreſſed by a ſemitone, (♭ being the mark of a flat).

The natural (marked thus ♮) reſtores to its natural value a note which had been raiſed or depreſſed by a ſemitone.

See fig. R.

173. When you place at the cleff a ſharp or a flat, all the notes upon the line on which this ſharp or flat is marked are ſharp or flat. Thus let us take, for inſtance, the cleff of *ut* upon the firſt line, and let us place a ſharp in the ſpace between the ſecond and third line, which is the place of *fa*; all the notes which ſhall be marked in that ſpace will be *fa*♯; and if you would reſtore them to their original value of *fa* natural, you muſt place a ♮ or a ♭ before them.

See fig. S.

In the ſame manner, if a flat be marked at the cleff, and if you would reſtore the note to its natural ſtate, you muſt place a ♮ or a ♯ before it.

See fig. X.

235 Bars and times, what.

174. Every piece of muſic is divided into different equal times, which they call *meaſures* or *bars*; and each bar is likewiſe divided into different times.

See *Time*.

There are properly two kinds of meaſures or modes of time (*See* T): the meaſure of two times, or of common time, which is marked by the figure 2 placed at the beginning of the tune; and the meaſure of three times, or of triple time, which is marked by the figure 3 placed in the ſame manner. (*See* V.)

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The different bars are diſtinguiſhed by perpendicular lines.

In a bar we diſtinguiſh between the *perfect* and *imperfect* time; the *perfect* time is that which we *beat*, the *imperfect* that in which we *lift up the hand or foot*. A bar conſiſting of four times ought to be regarded as compounded of two bars, each conſiſting of two times: thus there are in this bar two perfect and two imperfect times. In general, by the words *perfect* and *imperfect*, even the parts of the ſame time are diſtinguiſhed: thus the firſt note of each time is reckoned as belonging to the *perfect* part, and the others as belonging to the *imperfect*.

See fig. Y.

236 The value of notes in duration.

175. The longeſt of all notes is a ſemibreve. A minim is half its value; that is to ſay, in ſinging, we only employ the ſame duration in performing two minims which was occupied in one ſemibreve. A minim in the ſame manner is equivalent to two crotchets, the crotchet to two quavers, &c.

237 Syncopation, what.

176. A note which is divided into two parts by a time, that is to ſay, which begins at the end of a time, and terminates in the time following, is called (ss) a *ſyncopated note*. (*See* Z; where the notes *ut*, *ſi*, and *la*, are each of them ſyncopated.) (†).

See *Syncopation*.

177. A

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is on the loweſt line of the firſt cleff of *fa*, is lower by two whole octaves than the *ſol* which is on the loweſt line of the ſecond cleff of *ſol*.

[Thus far the tranſlator has followed his original as accurately as poſſible; but this was by no means an eaſy taſk. Among all the writers on muſic which he has found in Engliſh, there is no ſuch thing as different names for each particular part which is employed to conſtitute full or complete harmony. He was therefore under a neceſſity of ſubſtituting by analogy ſuch names as appeared moſt expreſſive of his author's meaning. To facilitate this attempt, he examined in Rouſſeau's muſical dictionary the terms by which the different parts were denominated in D'Alembert; but even Rouſſeau, with all his depth of thought and extent of erudition, inſtead of expreſſing himſelf with that preciſion which the ſubject required, frequently applies the ſame names indiſcriminately to different parts, without aſſigning any reaſon for this promiſcuous and licentious uſe of words. The Engliſh reader therefore will be beſt able to form an accurate idea of the different parts, by the nature and ſituation of the cleffs with which they are marked; and if he ſhould find any impropriety in the names which are given them, he may adopt and aſſociate others more agreeable to his ideas.]

(ss) Syncopation conſiſts in a note which is protracted in two different times belonging partly to the one and partly to the other, or in two different bars; yet not ſo as entirely to occupy or fill up the two times, or the two bars. A note, for inſtance, which begins in the imperfect time of a bar, and which ends in the perfect time of the following, or which in the ſame bar begins in the imperfect part of one time and ends in the perfect of the following, is ſyncopated. A note which of itſelf occupies one or two bars, whether the meaſure conſiſts of two or three times, is not conſidered as ſyncopated: this is a conſequence of the preceding definition. This note is ſaid to be *continued* or *protracted*. In the end of the example Z, the *ut* of the firſt bar conſiſting of three times is not ſyncopated, becauſe it occupies two whole times. It is the ſame caſe with *mi* of the ſecond bar, and with the *ut* of the fourth and fifth. Theſe therefore are continued or protracted notes.

(†) *Times* and *bars* in muſic anſwer the very ſame end as punctuation in language. They determine the different periods of the movement, or the various degree of completion, which the ſentiment, expreſſed by that movement, has attained. Let us ſuppoſe, for inſtance, a compoſer in muſic intending to expreſs grief or joy, in all its various gradations, from its firſt and fainteſt ſenſation, to its acme or higheſt poſſible degree. We do not ſay that ſuch a progreſs of any paſſion either has been or can be delineated in practice, yet it may ſerve to illuſtrate what we mean to explain. Upon this hypotheſis, therefore, the degrees of the ſentiment will paſs from leſs to more ſenſible, as it riſes to its moſt intenſe degree. The firſt of theſe gradations may be called a *time*, which is likewiſe the moſt convenient diviſion of a bar or meaſure into its elementary or aliquot parts, and may be deemed equivalent to a comma in a ſentence; a bar denotes a degree ſtill more ſenſible, and may be conſidered as having the force of a ſemicolon; a ſtrain brings the ſentiment to a tolerable degree of perfection, and may be reckoned equal to a colon: the full period is the end of the imitative piece. It muſt have been remarked by obſervers of meaſure in melody or harmony, that the notes of which a bar or meaſure conſiſts, are not diverſified by their different durations alone, but likewiſe by greater or leſſer degrees of emphaſis.

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238 Value of a pointed note.

177. A note followed by a point or dot is increaſed half its value. The *ſi*, for inſtance, in the fifth bar of the example Y, followed by a point, has the value (*) or duration of a minim and of a crotchet at the ſame time.

CHAP. IV. *Containing a Definition of the principal Chords.*

239 Perfect chords, what.

178. THE chord compoſed of a third, a fifth, and an octave, as *ut mi ſol ut*, is called a *perfect chord* (art. 32.)

If the third be major, as in *ut mi ſol ut*, the perfect chord is denominated *major*: if the third be minor, as in *la ut mi la*, the perfect chord is minor. The perfect chord major conſtitutes what we call the *major mode*; and the perfect chord minor, what we term the *minor mode* (art. 31).

240 Chord of the ſeventh, what, and how to be practiſed.

179. A chord compoſed of a third, a fifth, and a ſeventh, as *ſol ſi re fa*, or *re fa la ut*, &c. is called a *chord of the ſeventh*. It is obvious that ſuch a chord is wholly compoſed of thirds in aſcending.

All chords of the ſeventh are practiſed in harmony, ſave that which might carry the third minor and the ſeventh major, as *ut mi♭ ſol ſi*; and that which might carry a falſe fifth and a ſeventh major, as *ſi re fa la*♯, (chap. xiv. Part I.)

241 Thoſe of different kinds.

180. As thirds are either major or minor, and as they may be differently arranged, it is clear that there are different kinds of chords of the ſeventh; there is even one, *ſi re fa la*, which is compoſed of a third, a falſe fifth, and a ſeventh.

242 Of the greater ſixth, what.

181. A chord compoſed of a third, a fifth, and a ſixth, as *fa la ut re*, *re fa la ſi*, is called a *chord of the greater ſixth*.

182. Every note which carries a perfect chord is called a *tonic*, and a perfect chord is marked by an 8, by a 3, or by a 5, which is written above the note; but frequently theſe numbers are ſuppreſſed. Thus in the example I. the two *ut*'s equally carry a perfect chord.

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243 Tonic, what, and its chords, how figured.

183. Every note which carries a chord of the ſeventh is called a *dominant* (art. 102); and this chord is marked by a 7 written above the note. Thus in the example II. *re* carries the chord *re fa la ut*, and *ſol* the chord *ſol ſi re fa*.

244 Dominant, what, and how figured.

It is neceſſary to remark, that among the chords of the ſeventh we do not reckon the chord of the ſeventh diminiſhed, which is only improperly called a *chord of the ſeventh*; and of which we ſhall ſay more below. [244]

Sub-dominant, what, and how figured.

184. Every note which carries the chord of the great ſixth, is called a *ſubdominant*, (art. 97, and 42.) and is marked with a 6. Thus in the example III. *fa* caries the chord of *fa la ut re*. You ought to remark that the ſixth ſhould always be major, (art. 97, and 109).

245 Fundamental note, what.

185. In every chord, whether perfect, or a chord of the ſeventh, or of the great ſixth, the note which carries this chord, and which is the flatteſt or loweſt, is called the *fundamental note*. Thus *ut* in the example I. *re* and *ſol* in the example II. and *fa* in the example III. are fundamental notes.

See *Fundamental*.

246 Diſſonance of a chord, what.

186. In every chord of the ſeventh, and of the great ſixth, the note which forms the ſeventh or ſixth above the fundamental, that is to ſay, the higheſt note of the chord, is called a *diſſonance*. Thus in the chords of the ſeventh *ſol ſi re fa*, *re fa la ut*, *fa* and *ut* are the diſſonances, viz. *fa* with relation to *ſol* in the firſt chord, and *ut* with relation to *re* in the ſecond. In the chord of the great ſixth *fa la ut re*, *re* is the diſſonance (art. 120.); but that *re* is only, properly

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phaſis. The moſt emphatic parts of a bar are called the *accented parts*; thoſe which require leſs energy in expreſſion are called the *unaccented*. The ſame obſervation holds with regard to times as bars. The ſtroke, therefore, of the hand or foot in beating marks the accented part of the bar, the elevation or preparation for the ſtroke marks the unaccented part. Let us once more reſume our compoſition intended to expreſs the different periods in the progreſs of grief or joy. There are ſome revolutions in each of theſe ſo rapid as not to be marked by any ſenſible tranſition whether diatonic or conſonant. In this caſe, the moſt expreſſive tone may be continued from one part of a time or meaſure to another, and end before the period of that time or meaſure in which it begins. Here therefore is a natural principle upon which the practice of ſyncopation may be founded even in melody: but when muſic is compoſed in different parts to be ſimultaneouſly heard, the continuance of one note not divided by regular times and meaſures, nor beginning and ending with either of them, whilſt the other parts either aſcend or deſcend according to the regular diviſions of the movement, has not only a ſenſible effect in rendering the imitation more perfect, but even gives the happieſt opportunities of diverſifying the harmony, which of itſelf is a moſt delightful perception.

For the various diſpoſitions of accent in times and meaſures, according to the movement of any piece, ſee a Treatiſe on Muſic by Alexander Malcolm.

For the opportunity of diverſifying harmony afforded by ſyncopation, ſee Rameau's Principles of Compoſition.

(*) To prevent ambiguity or confuſion of ideas, it is neceſſary to inform our readers, that we have followed M. D'Alembert in his double ſenſe of the word *value*, though we could have wiſhed he had diſtinguiſhed the different meanings by different words. A ſound may be either eſtimated by its different degrees of intenſeneſs, or by its different quantities of duration.

To ſignify both thoſe ideas the word *value* is employed by D'Alembert. The reader, therefore, will find it of importance to diſtinguiſh the value of a note in height from its value in duration. This he may eaſily do, by conſidering whether the notes are treated as parts of the diatonic ſcale, or as continued for a greater or leſſer duration.

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properly ſpeaking, a diſſonance with relation to *ut* from which it is a *ſecond*, and not with reſpect to *fa* from which it is a *ſixth major* (art. 17, and 18).

247 Tonic and ſimple dominant, what.

187. When a chord of the ſeventh is compoſed of a third major followed by two thirds minor, the fundamental note of this chord is called the *tonic dominant*. In every other chord of the ſeventh the fundamental is called the *ſimple dominant* (art. 102.). Thus in the chord *ſol ſi re fa*, the fundamental *ſol* is the *tonic dominant;* but in the other chords of the ſeventh, as *ut mi ſol ſi*, *re fa la ut*, &c. the fundamentals *ut* and *re* are *ſimple dominants*.

248 Major chords, how rendered minor, and *vice verſa*.

188. In every chord, whether perfect, or of the ſeventh, or of the ſixth, if you have a mind that the third above the fundamental note ſhould be major, though it is naturally minor, you muſt place a ſharp above the fundamental note. For example, if I would mark the perfect major chord *re fa♯ la re*, as the third *fa* above *re* is naturally minor, I place above *re* a ſharp, as you may ſee in example IV. In the ſame manner the chord of the ſeventh *re fa♯ la ut*, and the chord of the great ſixth *re fa♯ la ſi*, is marked with a ♯ above *re*, and above the ♯ a 7 or a 6 (ſee V. and VI.).

On the contrary, when the third is naturally major, and if you ſhould incline to render it minor, you muſt place above the fundamental note a ♭. Thus the examples VII. VIII. IX. ſhow the chords *ſol ſi♭ re ſol*, *ſol ſi♭ re fa*, *ſol ſi♭ re mi* (TT).

CHAP. V. *Of the Fundamental Baſs.*

249 Fundamental baſs, how formed.

189. INVENT a modulation at your pleaſure; and under this modulation let there be ſet a baſs compoſed of different notes, of which ſome may carry a perfect chord, others that of the ſeventh, and others that of the great ſixth, in ſuch a manner that each note of the modulation which anſwers to each of the baſs, may be one of thoſe which enters into the chord of that note in the baſs; this baſs being compoſed according to the rules which ſhall be immediately given, will be the *fundamental baſs* of the modulation propoſed. See Part I. where *the nature and principles of the fundamental baſs* are explained. Principles of Compoſition. See *Fundamental baſs*.

Thus (Exam. XVIII.) you will find that this modulation, *ut re mi fa ſol la ſi ut*, has or may admit for its fundamental baſs, $ut\ ſol^{7}\ ut\ fa^{6}\ ut\ re^{7}\ ſol^{7}\ ut$.

In reality, the firſt note *ut* in the upper part is found in the chord of the firſt note *ut* in the baſs, which chord is *ut mi ſol ut;* the ſecond note *re* in the treble is found in the chord *ſol ſi re fa*, which is the chord of the ſecond note in the baſs, &c. and the baſs is compoſed only of notes which carry a perfect chord, or that of the ſeventh, or that of the great ſixth. Moreover, it is formed according to the rules which we are now about to give.

CHAP. VI. *Rules for the Fundamental Baſs.*

250 Rules for the formation of this baſs.

190. ALL the notes of the fundamental baſs being only capable of carrying a perfect chord, or the chord of the ſeventh, or that of the great ſixth, are either tonics, or dominants, or ſub-dominants; and the dominants may be either ſimple or tonic.

The fundamental baſs ought always to begin with a tonic, as much as it is practicable. And now follow the rules for all the ſucceeding chords; rules which are evidently derived from the principles eſtabliſhed in the *Firſt Part* of this treatiſe. To be convinced of this, we ſhall find it only neceſſary to review the articles 34, 91, 122, 124, 126, 127.

RULE I.

191. In every chord of the tonic, or of the tonic dominant, it is neceſſary that at leaſt one of the notes which form that chord ſhould be found in the chord that precedes it.

RULE II.

192. In every chord of the ſimple dominant, it is neceſſary

(TT) We may only add, that there is no occaſion for marking theſe ſharps or flats when they are originally placed at the cleff. For inſtance, if the ſharp be upon the cleff of *fa* (ſee Exam. X.), one may ſatisfy himſelf with ſimply writing *re*, without a ſharp to mark the perfect chord major of *re*, *re fa♯ la re*. In the ſame manner, in the Example XI. where the flat is at the cleff upon *ſi*, one may ſatisfy himſelf with ſimply writing *ſol*, to mark the perfect chord minor of *ſol ſi♭ re ſol*.

But if a caſe occurs where there is a ſharp or a flat at the cleff, if any one ſhould wiſh to render the chord minor which is major, or *vice verſa*, he muſt place above the fundamental note a ♮ or natural. Thus the Example XII. marks the minor chord *re fa la re*, and Example XIII. the major chord *ſol ſi re ſol*.—Frequently, in lieu of a natural, a flat is uſed to ſignify the minor chord, and a ſharp to ſignify the major. Thus Example XIV. marks the minor chord *re fa la re*, and Example XV. the major chord *ſol ſi re ſol*.

When in a chord of the great ſixth, the diſſonance, that is to ſay, the ſixth, ought to be ſharp, and when the ſharp is not found at the cleff, they write before or after the 6 a ♯; and if this ſixth ſhould be flat according to the cleff, they write a ♮.

In the ſame manner, if in a chord of the ſeventh of the tonic dominant, the diſſonance, that is to ſay, the ſeventh, ought to be flat or natural, they write by the ſide of the ſeventh a ♭ or a ♮. Many muſicians, when a ſeventh from the ſimple dominant ought to be altered by a ſharp or a natural, have likewiſe written by the ſide of the ſeventh a ♯ or a ♮; but M. Rameau ſuppreſſes theſe characters. The reaſon ſhall be given below, when we ſpeak of chords by ſuppoſition.

If there be a ſharp on the cleff of *fa*, and if I ſhould incline to mark the chord *ſol ſi re fa*, or the chord *la ut mi fa*, I would place before the ſeventh or the ſixth a ♮ or a ♭.

In the ſame manner, if there be a flat on the cleff at *ſi*, and if I ſhould incline to mark the chord *ut mi ſol ſi♭*, I would place before the ſeventh a ♯ or a ♮; and ſo of the reſt.

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neceſſary that the note which conſtitutes the ſeventh, or diſſonance, ſhould likewiſe be found in the preceding chord.

RULE III.

193. In every chord of the ſub-dominant, at leaſt one of its conſonances muſt be found in the preceding chord. Thus, in the chord of the ſub-dominant *fa la ut re*, it is neceſſary that *fa*, *la*, or *ut*, which are the conſonances of the chord, ſhould be found in the chord preceding. The diſſonance *re* may either be found in it or not.

RULE IV.

194. Every ſimple or tonic dominant ought to deſcend by a fifth. In the firſt caſe, that is to ſay, when the dominant is ſimple, the note which follows can only be a dominant; in the ſecond it may be any one you chooſe; or, in other words, it may either be a tonic, a tonic dominant, a ſimple dominant, or a ſub-dominant. It is neceſſary, however, that the conditions preſcribed in the ſecond rule ſhould be obſerved, if it be a ſimple dominant.

This laſt reflection is neceſſary, as you will preſently ſee. For let us aſſume the ſucceſſion of the two chords *la ut*♯ *mi ſol*, *re fa la ut* (ſee Exam. XIX.), this ſucceſſion is by no means legitimate, though in it the firſt dominant deſcends by a fifth; becauſe the *ut* which forms the diſſonance in the ſecond chord, and which belongs to a ſimple dominant, is not in the preceding chord. But the ſucceſſion will be admiſſible, if, without meddling with the ſecond chord, one ſhould take away the ſharp carried by the *ut* in the firſt; or if, without meddling with the firſt chord, one ſhould render *ut* or *fa* ſharp in the ſecond (uu); or in ſhort, if one ſhould ſimply render the *re* of the ſecond chord a tonic dominant, in cauſing it to carry *fa*♯ inſtead of *fa* natural (119. & 122.).

It is likewiſe by the ſame rule that we ought to reject the ſucceſſion of the two following chords,

re fa la ut, *ſol ſi re fa*♯;

(ſee Exam. XX.).

RULE V.

195. Every ſub-dominant ought to riſe by a fifth; and the note which follows it may, at your pleaſure, be either a tonic, a tonic dominant, or a ſub-dominant.

REMARK.

251 Other rules ſubſtituted.

Of the five fundamental rules which have now been given, inſtead of the three firſt, one may ſubſtitute the three following, which are nothing but conſequences from them, and which you may paſs unnoticed if you think it proper.

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RULE I.

If a note of the fundamental baſs be a tonic, and riſe by a fifth or a third to another note, that ſecond note may be either a *tonic* (34. & 91.), ſee Examples XXI. and XXII. (xx); a *tonic dominant* (124.), ſee XXIII. and XXIV.; or a *ſub-dominant* (124.), ſee XXV. and XXVI.; or, to expreſs the rule more ſimply, that ſecond note may be any one you pleaſe, except a *ſimple dominant*.

RULE II.

If a note of the fundamental baſs be a tonic, and deſcend by a fifth or a third upon another note, this ſecond note may be either a tonic (34. & 91.), ſee Exam. XXVII. and XXVIII.; or a tonic dominant, or a ſimple dominant, yet in ſuch a manner that the rule of art. 192. may be obſerved (124.), ſee XXIX. XXX. XXXI. XXXII.; or a ſub-dominant (124.), ſee XXXIII. and XXXIV.

The procedure of the baſs *ut mi*♭ *ſol ut*, *fa la ut mi*, from the tonic *ut* to the dominant *fa* (Ex. XXXV.), is excluded by art. 192.

RULE III.

If a note in the fundamental baſs be a tonic, and riſe by a ſecond to another note, that note ought to be a tonic dominant, or a ſimple dominant (101. & 102.). See XXXVI. and XXXVII. (yy).

We muſt here advertiſe our readers, that the examples XXXVIII. XXXIX. XL. XLI. belong to the fourth rule above, art. 194.; and the examples XLII. XLIII. XLIV. to the fifth rule above, art. 195. See the articles 34, 35, 121, 123, 124.

REMARK I.

252 Perfect and imperfect cadences, what, and how employed.

196. The tranſition from a tonic dominant to a tonic is called an *abſolute repoſe*, or a *perfect cadence* (73.); and the tranſition from a ſub-dominant to a tonic is called an *imperfect* or *irregular cadence* (73.); the cadences are formed at the diſtance of four bars one from another, whilſt the tonic then falls within the firſt time of the bar. See XLV. and XLVI.

REMARK II.

253 Syncopation only admiſſible in the fundamental baſs by licence.

197. We muſt avoid, as much as we can, ſyncopations in the fundamental baſs; that, within the firſt time of which a bar is conſtituted, the ear may be entertained with a harmony different from that which it had

(uu) In this chord it is neceſſary that the *ut* and *fa* ſhould be ſharp at the ſame time; for the chord *re fa la ut*♯, in which *ut* would be ſharp without the *fa*, is excluded by art. 179.

(xx) When the baſs riſes or deſcends from one tonic to another by the interval of a third, the mode is commonly changed; that is to ſay, from a major it becomes a minor. For inſtance, if I aſcend from the tonic *ut* to the tonic *mi*, the major mode of *ut*, *ut mi ſol ut*, will be changed into the minor mode of *mi*, *mi ſol ſi mi*. For what remains, we muſt never aſcend from one tonic to another, when there is no ſound common to both their modes: for example, you cannot riſe to the mode of *ut*, *ut mi ſol ut*, from the minor mode of *mi*♭. *mi*♭ *ſol*♭ *ſi*♭ *mi*♭ (91.)

(yy) By this we may ſee, that all the intervals, viz. the third, the fifth, and ſecond, may be admitted in the fundamental baſs, except that of a ſecond in deſcending. For what remains, it is very proper to remark, that the rules immediately given for the fundamental baſs are not without exception, as approved compoſitions in muſic will certainly diſcover; but theſe exceptions being in reality licences, and for the moſt part in oppoſition to the great principle of connection, which preſcribes that there ſhould be at leaſt one note in common between a preceding and a ſubſequent chord, it does not ſeem neceſſary to entertain initiates with a minute detail of theſe licences in an elementary work, where the firſt and moſt eſſential rules of the art alone ought to be expected.

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had before perceived in the laſt time of the preceding bar. Nevertheleſs, ſyncopation may be ſometimes admitted in the fundamental baſs, but it is by a licence (zz).

Chap. VII. *Of the Rules which ought to be obſerved in the Treble with relation to the Fundamental Baſs.*

254 Definition of treble.

198. The treble is nothing elſe but a modulation above the fundamental baſs, and whoſe notes are found in the chords of that baſs which correſponds with it (189.). Thus in Ex. XVIII. the ſcale *ut re mi fa ſol la ſi ut*, is a treble with reſpect to the fundamental baſs *ut ſol ut fa ut re ſol ut*.

255 One note in the treble or baſs may anſwer to ſeveral of its correſpondent parts, and why.

199. We are juſt about to give the rules for the treble; but firſt we think it neceſſary to make the two following remarks.

1. It is obvious, that many notes of the treble may anſwer to one and the ſame note in the fundamental baſs, when theſe notes belong to the chord of the ſame note in the fundamental baſs. For example, this modulation *ut mi ſol mi ut*, may have for its fundamental baſs the note *ut* alone, becauſe the chord of that note comprehends the ſounds *ut*, *mi*, *ſol*, which are found in the treble.

2. In like manner, a ſingle note in the treble may, for the ſame reaſon, anſwer to ſeveral notes in the baſs. For inſtance, *ſol* alone may anſwer to theſe three notes in the baſs, *ut ſol ut* (AAA).

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Rule I. *for the Treble.*

200. If the note which forms the ſeventh in a chord of the *ſimple dominant* is found in the treble, the note which precedes it muſt be the very ſame. This is what we call a *diſcord prepared* (122). For inſtance, let us ſuppoſe that the note of the fundamental baſs ſhall be *re*, bearing the chord of the ſimple dominant *re fa la ut*; and that this *ut*, which (art. 18. and 118.) is the diſſonance, ſhould be found in the treble; it is neceſſary that the note which goes before it in the treble ſhould likewiſe be an *ut*.

201. And it is requiſite to obſerve, that, according to the rules which we have given for the fundamental baſs, *ut* will always be found in the chord of that note in the fundamental baſs which precedes the ſimple dominant *re*. See XLVIII. XLIX. L. In the firſt example the diſſonance is *ut*, in the ſecond *ſol*, and in the third *mi*; and theſe notes are already in the preceding chord (BBB).

Rule II.

202. If a note of the fundamental baſs be a tonic dominant, or a ſimple dominant, and if the diſſonance be found in the treble, this diſſonance in the ſame treble ought to deſcend diatonically. But if the note

(zz) There are notes which may be found ſeveral times in the fundamental baſs in ſucceſſion with a different harmony. For inſtance, the tonic *ut*, after having carried the chord *ut mi ſol ut*, may be followed by another *ut* which carries the chord of the ſeventh, provided that this chord be the chord of the tonic dominant *ut mi ſol ſi♭*. See LXXII. In the ſame manner, the tonic *ut* may be followed by the ſame tonic *ut*, which may be rendered a *ſub-dominant*, by cauſing it to carry the chord *ut mi ſol la*. See LXXIII.

A dominant, whether tonic or ſimple, ſometimes deſcends or riſes upon one another by the interval of a tritone or falſe fifth. For example, the dominant *ſa*, carrying the chord *ſa la ut mi*, may be followed by another dominant *ſi*, carrying the chord *ſi re fa la*. This is a licence in which the muſician indulges himſelf, that he may not be obliged to depart from the ſcale in which he is; for inſtance, from the ſcale of *ut* to which *fa* and *ſi* belong. If one ſhould deſcend from *ſa* to *ſi♭* by the interval of a juſt fifth, he would then depart from that ſcale, becauſe *ſi♭* is no part of it.

(AAA) There are often in the treble ſeveral notes which may, if we chooſe, carry no chord, and be regarded merely as notes of paſſage, ſerving only to connect between themſelves the notes that do carry chords, and to form a more agreeable modulation. Theſe notes of paſſage are commonly quavers. See Exam. XLVII. in which this modulation *ut re mi fa ſol*, may be regarded as equivalent to this other, *ut mi ſol*, as *re* and *fa* are no more than notes of paſſage. So that the baſs of this modulation may be ſimply *ut ſol*.

When the notes are of equal duration, and arranged in a diatonic order, the notes which occupy the perfect part of each time, or thoſe which are accented, ought each of them to carry chords. Thoſe which occupy the imperfect part, or which are unaccented, are no more than mere notes of paſſage. Sometimes, however, the note which occupies the imperfect part may be made to carry harmony; but the value of this note is then commonly increaſed by a point which is placed after it, which proportionably diminiſhes the continuance of the note that occupies the perfect time, and makes it paſs more ſwiftly.

When the notes do not move diatonically, they ought generally all of them to enter into the chord which is placed in the lower part correſpondent with theſe notes.

(BBB) There is, however, one caſe in which the ſeventh of a ſimple dominant may be found in a modulation without being prepared. It is when, having already employed that dominant in the fundamental baſs, its ſeventh is afterwards heard in the modulation, as long as this dominant may be retained. For inſtance, let us imagine this modulation,

	ut	*re*	*ut*	*ſi*	*ut*	*re*;	
and this fundamental baſs,	*ut*	7 *re*		7 *ſol*	*ut*	7 *ſol*	

(ſee Example LI.); the 7 *re* of the fundamental baſs anſwers to the two notes *re ut* of the treble. The diſſonance *ut* has no need of preparation, becauſe the note 7 *re* of the fundamental baſs having already been employed for the *re* which precedes *ut*, the diſſonance *ut* is afterwards preſented, below which the chord *re* may be preſerved, or *re fa la ut*.

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of the baſs be a ſub-dominant, it ought to riſe diatonically. This diſſonance, which riſes or deſcends diatonically, is what we have called a *diſſonance ſaved* or *reſolved* (129, 130.). See LII. LIII. LIV.

203. One may likewiſe obſerve here, that, according to the rules for the fundamental baſs which we have given, the note upon which the diſſonance ought to deſcend or riſe will always be found in the ſubſequent chord (ccc).

CHAP. VIII. *Of the Continued Baſs, and its Rules.*

* See *Continued baſs.*

256 Thorough-baſs, what.

204. A CONTINUED * or thorough baſs, is nothing elſe but a fundamental baſs whoſe chords are *inverted*. We invert a chord when we change the order of the notes which compoſe it. For example, if inſtead of the chord *ſol ſi re fa*, I ſhould ſay *ſi re fa ſol* or *re fa ſol ſi*, &c. the chord is inverted. Let us ſee then, in the firſt place, all the poſſible ways in which a chord may be inverted.

257 Chords inverted, how.

The ways in which a PERFECT CHORD *may be* INVERTED.

205. The perfect chord *ut mi ſol ut* may be inverted in two different ways.

1. *Mi ſol ut mi*, which we call a chord of the *ſixth*, compoſed of a third, a ſixth, and an octave, and in this caſe the note *mi* is marked with a 6. (See LVI.)

2. *Sol ut mi ſol*, which we call a *chord of the ſixth and fourth*, compoſed of a fourth, a ſixth, and an octave; and it is marked with a $\frac{6}{4}$. (See LVII.)

The perfect minor chord is inverted in the ſame manner.

The ways in which the CHORD *of the* SEVENTH *may be* INVERTED.

206. In the chord of the tonic dominant, as *ſol ſi re fa*, the third major *ſi* above the fundamental note *ſol* is called a *ſenſible note* (77.); and the inverted chord *ſi re fa ſol*, compoſed of a third, a falſe fifth, and ſixth, is called the *chord of the falſe fifth*, and is marked with an 8 or a ♭5 (ſee LVIII. and LIX.)

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The chord *re fa ſol ſi*, compoſed of a third, a fourth, and a ſixth, is called the *chord of the ſenſible ſixth*, and marked with a 6 or a ♯6. In this chord thus figured, the third is minor, and the ſixth major, as it is eaſy to be perceived. (See LX.)

The chord *fa ſol ſi re*, compoſed of a ſecond, a tritone, and a ſixth, is called the *chord of the tritone*, and is marked thus 4+, thus ×4, or thus ♯4. (See LXI.)

207. In the chord of the ſimple dominant *re fa la ut*, we find,

1. *Fa la ut re*, a chord of the great ſixth, which is compoſed of a third, a fifth, and a ſixth, and which is figured with a $\frac{6}{5}$. See LXIII. (DDD).

2. *La ut re fa*, a chord of the leſſer ſixth, which is figured with a 6. See LXIV. (EEE).

3. *Ut re fa la*, a chord of the ſecond, compoſed of a ſecond, a fourth, and a ſixth, and which is marked with a 2. See LXII. (FFF).

The ways in which the CHORD *of the ſub-*DOMINANT *may be inverted.*

208. The chord of the ſub-dominant, as *fa la ut re*, may be inverted in three different manners; but the method of inverting it which is moſt in practice is the chord of the leſſer ſixth *la ut re fa*, which is marked with a 6, and the chord of the ſeventh *re fa la ut*. See LXIV.

RULES for the CONTINUED BASS.

209. The continued baſs is a fundamental baſs, whoſe chords are only inverted in order to render it more in the taſte of ſinging, and ſuitable to the voice. See LXV. in which the fundamental baſs which in itſelf is monotonic and little ſuited for ſinging, *ut ſol ut ſol ut ſol ut*, produces, by inverting its chords, this continued

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(ccc) When the treble ſyncopates in deſcending diatonically, it is common enough to make the ſecond part of the ſyncope carry a diſcord, and the firſt a concord. See *Example* LV. where the firſt part of the ſyncopated note *ſol* is in concord with the notes *ut mi ſol ut*, which anſwer to it in the fundamental baſs, and where the ſecond part is a diſſonance in the ſubſequent chord *la ut mi ſol*. In the ſame manner, the firſt part of the ſyncopated note *fa* is in concord with the notes *re fa la ut*, which anſwer to it; and the ſecond part is a diſſonance in the ſubſequent chord *ſol ſi re fa*, which anſwer to it, &c.

(DDD) We are obliged to mark likewiſe, in the continued baſs, the chord of the ſub-dominant with a $\frac{6}{5}$, which in the fundamental baſs is figured with a 6 alone; and this to diſtinguiſh it from the chords of the ſixth and of the leſſer ſixth. (See Examples LVI. and LXIV.) For what remains, the chord of the great ſixth in the fundamental baſs carries always the ſixth major, whereas in the continued baſs it may carry the ſixth minor. For inſtance, the chord of the ſeventh *ut mi ſol ſi*, gives the chord of the great ſixth *mi ſol ſi ut*, thus improperly called, ſince the ſixth from *mi* to *ut* is minor.

(EEE) M. Rameau has juſtly obſerved, that we ought rather to figure this leſſer ſixth with a $\frac{3}{4}$, to diſtinguiſh it from the ſenſible ſixth which ariſes from the chord of the tonic dominant, and from the ſixth which ariſes from the perfect chord. In the mean time he figures in his works with a 6 alone, the leſſer ſixths which do not ariſe from the tonic dominant; that is to ſay, he figures them as thoſe which ariſe from the perfect chord; and we have followed him in that, though we thought with him, that it would be better to mark this chord by a particular figure.

(FFF) The chord of the ſeventh *ſi re fa la* gives, when inverted, the chord *fa la ſi re*, compoſed of a third, a tritone, and a ſixth. This chord is commonly marked with a 6, as if the tritone were a juſt fourth. It is his buſineſs who performs the accompaniment, to know whether the fourth above *fa* be a tritone or a fourth redundant. One may, as to what remains, figure this chord thus $\frac{6}{4}$*.

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tinued baſs highly proper to be ſung, *ut ſi ut re mi fa mi*, &c. (GGG.)

The continued baſs then is properly nothing elſe but a treble with reſpect to the fundamental baſs. Its rules immediately follow, which are properly no other than thoſe already given for the treble.

RULE I.

210. Every note which carries the chord of the falſe fifth, and which of conſequence muſt be what we have called a *ſenſible note*, ought (77) to riſe diatonically upon the note which follows it. Thus in example LXV. the note *ſi*, carrying the chord of the falſe fifth marked with an 8, riſes diatonically upon *ut* (HHH).

RULE II.

211. Every note carrying the chord of the tritone ſhould deſcend diatonically upon the ſubſequent note. Thus in the ſame example LXV. *fa*, which carries the chord of the tritone figured with a 4+, deſcends diatonically upon *mi*. (Art. 202.)

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RULE III.

212. The chord of the ſecond is commonly put in practice upon notes which are ſyncopated in deſcending, becauſe theſe notes are diſſonances which ought to be prepared and reſolved (200, 202.) See the example LXVI. where the ſecond *ut*, which is ſyncopated, and which deſcends afterwards upon *ſi*, carries the chord of the ſecond (111).

(GGG) The continued baſs is proportionably better adapted to ſinging, as the ſounds which form it more ſcrupulouſly obſerve the diatonic order, becauſe this order is the moſt agreeable of all. We muſt therefore endeavour to preſerve it as much as poſſible. It is for this reaſon that the continued baſs in Example LXV. is much more in the taſte of ſinging, and more agreeable, than the fundamental baſs which anſwers to it.

(HHH) The continued baſs being a kind of treble with relation to the fundamental baſs, it ought to obſerve the ſame rules with reſpect to that baſs as the treble. Thus a note, for inſtance *re*, carrying a chord of the ſeventh *re fa la ut*, to which the chord of the ſub-dominant *fa la ut re* correſponds in the fundamental baſs, ought to riſe diatonically upon *mi*, (art. 129, n° 2. and art. 202.)

(III) When there is a *repoſe* in the treble, the note of the continued baſs ought to be the ſame with that of the fundamental baſs, (ſee example LXVII.) In the cloſes which are found in the treble at *ſi* and *ut* (bars third and fourth), the notes in the fundamental and continued baſs are the ſame, viz. *ſol* for the firſt cadence, and *ut* for the ſecond. This rule ought above all to be obſerved in final cadences which terminate a piece or a modulation.

It is neceſſary, as much as poſſible, to prevent coincidences of the ſame notes in the treble and continued baſs, unleſs the motion of the continued baſs ſhould be contrary to that of the treble. For example, in the ſecond note of the ſecond bar in example LXVII. *mi* is found at the ſame time in the continued baſs and in the treble; but the treble deſcends from *fa* to *mi*, whilſt the baſs riſes from *re* to *mi*.

Two octaves, or two fifths, in ſucceſſion, muſt likewiſe be ſhunned. For inſtance, in the treble ſounds *ſol mi*, the baſs muſt be prevented from ſounding *ſol mi*, *ut la*, or *re ſi*, becauſe in the firſt caſe there are two octaves in ſucceſſion, *ſol* againſt *ſol*, and *mi* againſt *mi*; and becauſe in the ſecond caſe there are two fifths in ſucceſſion, *ut* againſt *ſol*, and *la* againſt *mi*, or *re* againſt *ſol*, and *ſi* againſt *mi*. This rule, as well as the preceding, is founded upon this principle, that the continued baſs ought not to be a copy of the treble, but to form a different melody.

Every time that ſeveral notes of the continued baſs anſwer to one note alone of the fundamental, the compoſer ſatisfies himſelf with figuring the firſt of them. Nay he does not even figure it if it be a tonic; and he draws above the others a line, continued from the note upon which the chord is formed. See example LXVIII. where the fundamental baſs *ut* gives the continued baſs *ut mi ſol mi*; the two *mi*'s ought in this baſs to carry the chord 6, and *ſol* the chord $\frac{6}{4}$: but as theſe chords are comprehended in the perfect chord *ut mi ſol ut*, which is the firſt of the continued baſs, we place nothing above *ut*, only we draw a line over *ut mi ſol mi*.

In like manner, in the ſecond bar of the ſame example, the notes *fa* and *re* of the continued baſs, riſing from the note *ſol* alone of the fundamental baſs which carries the chord *ſol ſi re fa*, we think it ſufficient to figure *fa* with the number of the tritone 4×, and to draw a line above *fa* and *re*.

It ſhould be remarked, that this *fa* ought naturally to deſcend to *mi*; but this note is conſidered as ſubſiſting ſo long as the chord ſubſiſts; and when the chord changes, we ought neceſſarily to find the *mi*, as may be ſeen by that example.

In general, whilſt the ſame chord ſubſiſts in paſſing through different notes, the chord is reckoned the ſame as if the firſt note of the chord had ſubſiſted; in ſuch a manner, that, if the firſt note of the chord is, for inſtance, the ſenſible note, we ought to find the tonic when the chord changes. See example LXIX. or this continued baſs, *ut ſi ſol ſi re ut*, is reckoned the ſame with this *ut ſi ut*. (Example LXX.)

If a ſingle note of the continued baſs anſwers to ſeveral notes of the fundamental baſs, it is figured with the different chords which agree to it For example, the note *ſol* in a continued baſs may anſwer to this fundamental baſs *ut ſol ut*, (ſee example LXXI.); in this caſe, we may regard the note *ſol* as divided into three parts, of which the firſt carries the chord $\frac{6}{4}$, the ſecond the chord 7, and the third the chord $\frac{6}{4}$.

We ſhall repeat here, with reſpect to the rules of the continued baſs, what we have formerly ſaid concerning the rules of the fundamental baſs in the note upon the third rule, art. 193. The rules of the continued baſs have exceptions, which practice and the peruſal of good authors will teach. There are likewiſe ſeveral other rules which might require a conſiderable detail, and which will be found in the *Treatiſe of Harmony* by M. Rameau, and elſewhere. Theſe rules, which are proper for a complete diſſertation, did not appear to me indiſpenſably neceſſary in an *elementary eſſay upon muſic*, ſuch as the preſent. The books which we have quoted at the end of our *preliminary diſcourſe* will more particularly inſtruct the reader concerning this practical detail.

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CHAP. IX. *Of ſome Licences aſſumed in the Fundamental Baſs.*

§ 1. *Of* BROKEN *and* INTERRUPTED CADENCES.

258 Broken cadence, how executed.

213. The broken cadence is executed by means of a dominant which riſes diatonically upon another, or upon a tonic by a licence. See, in the example LXXIV. *ſol la*, (132, and 134).

259 Interrupted cadence, how formed.

214. The interrupted cadence is formed by a dominant which deſcends by a third upon another (136). See, in the example LXXV. *ſol mi* (LLL).

Theſe cadences ought to be permitted but rarely and with precaution.

§ 2. *Of* SUPPOSITION.

260 Chord by ſuppoſition, what.

215. When a dominant is preceded by a tonic in the fundamental baſs, we add ſometimes, in the continued baſs to the chord of that dominant, a new note which is a third or a fifth below; and the chord which reſults from it in this continued baſs is called *a chord by ſuppoſition.*

See *Suppoſition.*

For example, let us ſuppoſe, that in the fundamental baſs we have a dominant *ſol* carrying the chord of the ſeventh *ſol ſi re fa*; let us add to this chord the note *ut*, which is a fifth below this dominant, and we ſhall have the total chord *ut ſol ſi re fa*, or *ut re fa ſol ſi*, which is called *a chord by ſuppoſition* (MMM.)

Of the different kinds of chords by ſuppoſition.

216. It is eaſy to perceive, that chords by ſuppoſition are of different kinds. For inſtance, the chord of the tonic *ſol ſi re fa* gives,

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261 Theſe different chords what, and how figured.

1. By adding the fifth *ut*, the chord *ut ſol ſi re fa*, called a *chord of the ſeventh redundant*, and compoſed of a fifth, ſeventh, ninth, and eleventh. It is figured with a ※ 7; ſee LXXVI. (NNN). This chord is not practiſed but upon the tonic. They ſometimes leave out the ſenſible note, for reaſons which we ſhall give in the note QQQ, upon the art. 219; it is then reduced to *ut fa ſol re*, and marked with $\frac{5}{4}$ or $\frac{5}{2}$.

2. By adding the third *mi*, we ſhall have the chord *mi ſol ſi re fa*, called a *chord of the ninth*, and compoſed of a third, fifth, ſeventh, and ninth. It is figured with a 9. This third may be added to every third of the dominant. See LXXVII. (OOO).

3. If to a chord of the ſimple dominant, as *re fa la ut*, we ſhould add the fifth *ſol*, we would have the chord *ſol re fa la ut*, called a *chord of the eleventh*, and which is figured with a $\frac{9}{4}$ or $\frac{4}{9}$. (See LXXVIII.)

OBSERVE.

262 Occaſions when retrenchments of chords are proper.

217. WHEN the dominant is not a tonic dominant, they often take away ſome notes from the chord. For example, let us ſuppoſe that there is in the fundamental baſs this ſimple dominant *mi*, carrying the chord *mi ſol ſi re*: if there ſhould be added the third *ut* beneath, we ſhall have this chord of the continued baſs *ut mi ſol ſi re*, but they ſuppreſs the ſeventh *ſi*, for reaſons which ſhall be explained in the note QQQ upon art.

(LLL) One may ſometimes, but very rarely, cauſe ſeveral tonics in ſucceſſion to follow one another in aſcending or deſcending diatonically, as *ut mi ſol ut*, *re fa la re*, *ſi♭ re fa ſi♭*; but, beſides that this ſucceſſion is harſh, it is neceſſary, in order to render it practicable, that the fifth below the firſt tonic ſhould be found in the chord of the tonic following, as here *fa*, a fifth below the firſt tonic *ut*, is found in the chord *re fa la re*, and in the chord *ſi♭ re fa ſi♭* (37 and note G.)

(MMM) Though ſuppoſition be a kind of licence, yet it is in ſome meaſure founded on the experiment related in the note (F), where you may ſee that every principal or fundamental ſound cauſes its twelfth and ſeventeenth major in deſcending to vibrate, whilſt the twelfth and the ſeventeenth major aſcending reſound: which ſeems to authorize us in certain caſes to join with the fundamental harmony this twelfth and ſeventeenth in deſcending; or, which is the ſame thing, the fifth or the third beneath the fundamental ſound.

Even without having recourſe to this experiment, we may remark, that the note added beneath the fundamental ſound, cauſes that very fundamental ſound to be heard. For inſtance, *ut* added beneath *ſol*, cauſes *ſol* to reſound. Thus *ſol* is found in ſome meaſure to be implied in *ut*.

If the third added beneath the fundamental ſound be minor, for example, if to the chord *ſol ſi re fa*, we add the third *mi*, the ſuppoſition is then no longer founded on the experiment, which only gives the ſeventeenth major, or, what is the ſame thing, the third major beneath the fundamental ſound. In this caſe the addition of the third minor muſt be conſidered as an extenſion of the rule, which in reality has no foundation in the chords emitted by a ſonorous body, but is authorized by the ſanction of the ear and by practical experiment.

(NNN) Many muſicians figure this chord with a $※^{7}_{2}$; M. Rameau ſuppreſſes this 2, and merely marks it to be the ſeventh redundant by a $7※$ or $※7$. But it may be ſaid, how ſhall we diſtinguiſh this chord from the ſeventh major, which, as it would ſeem, ought to be marked with a $7※$? M. Rameau anſwers, that there is no danger of miſtake, becauſe in the ſeventh major, as the ſeventh ought to be prepared, it is found in the preceding chord; and thus the ſharp ſubſiſting already in the preceding chord, it would be uſeleſs to repeat it. Thus *re ſol*, according to M. Rameau, would indicate *re fa*$^{7}_{※}$ *la ut*, *ſol ſi re fa*$※$. If we would change *fa*$^{7}_{※}$ of the ſecond chord into *fa*, it would then be neceſſary to write *re ſol*$^{7}_{7♮}$. In notes ſuch as *ut*, whoſe natural ſeventh is major, the figure 7 preceded or followed by a ſharp will ſufficiently ſerve to diſtinguiſh the chord of the ſeventh redundant *ut ſol ſi re fa*, from the ſimple chord of the ſeventh *ut mi ſol ſi*, which is marked with a 7 alone. All this appears juſt and well founded.

(OOO) Suppoſition introduces into a chord diſſonances which were not in it before. For inſtance, if to the chord *mi ſol ſi re*, we ſhould add the note of ſuppoſition *ut* deſcending by a third, it is plain that, beſides the

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art. 219. In this ſtate the chord is ſimply compoſed of a third, fifth, and ninth, and is marked with a 9. See LXXIX. (PPP)

218. What is more, in the chord of the ſimple dominant, as *re fa la ut*, when the fifth *ſol* is added, they frequently obliterate the ſounds *fa* and *la*, that too great a number of diſſonances may be avoided, which reduces the chord to *ſol ut re*. This laſt is compoſed only of the fourth and the fifth. It is called a *chord of the fourth*, and it is figured with a 4. (See LXXX.)

219. Sometimes they only remove the note *la*, and then the chord ought to be figured with $\frac{7}{4}$ or $\frac{4}{7}$ (QQQ).

263 Chord of the fifth redundant what, and how figured.

220. Finally, in the minor mode, for example, in that of *la*, where the chord of the tonic dominant (109,) is *mi ſol♯ ſi re*; if we add to this chord the third *ut* below, we ſhall have *ut mi ſol♯ ſi re*, called the *chord of the fifth redundant*, and compoſed of a third, a fifth redundant, a ſeventh, and a ninth. It is figured with a ♯5, or a +5. See LXXXI. (RRR.)

§ 3. *Of the* CHORD *of the* DIMINISHED SEVENTH.

264 Chord of the flat ſeventh what, and how figured.

221. In the minor mode, for inſtance, in that of *la*, *mi* a fifth from *la* is the tonic dominant (109), and carries the chord *mi ſol♯ ſi re*, in which *ſol* is the ſenſible note. For this chord they ſometimes ſubſtitute that other *ſol♯ ſi re fa*, (116), all compoſed of minor thirds; and which has for its fundamental ſound the ſenſible note *ſol♯*. This chord is called a *chord of the flat, or diminiſhed ſeventh*, and is figured with a ♭ in the fundamental baſs, (ſee LXXXII.): but it is always conſidered as repreſenting the chord of the tonic dominant.

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265 Chords produced in the continued baſs by this what, and how figured.

222. This chord in the fundamental baſs produces in the continued baſs the following chords:

1. The chord *ſi re fa ſol♯*, compoſed of a third, falſe fifth, and ſixth major. They call it the *chord of the ſixth ſenſible and falſe fifth*; and it is figured thus ♯$^{6}_{8}$, or +$^{6}_{8}$. (See LXXXIII).

2. The chord *re fa ſol♯ ſi*, compoſed of a third, a tritone, and a ſixth, they call it the *chord of the tritone and third minor*; and they mark it thus ♯$^{4}_{\flat}$. (See LXXXIV).

3. The chord *fa ſol♯ ſi re*, compoſed of a ſecond redundant, a tritone, and a ſixth. They call it the *chord of the ſecond redundant*, and they figure it thus ♯2, or +2. See LXXXV. (SSS).

266 Alterations by ſuppoſition, chords which they produce what, and how figured.

223. Beſides, ſince the chord *ſol♯ ſi re fa* repreſents the chord *mi ſol♯ ſi re*, it follows, that if we operate by ſuppoſition upon the firſt of theſe chords, it muſt be performed as one would perform it upon *mi*

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diſſonance between *mi* and *re* which was in the original chord, we have two new diſſonances, *ut ſi*, and *ut re*; that is to ſay, the ſeventh and the ninth. Theſe diſſonances, like the others, ought to be prepared and reſolved. They are prepared by being ſyncopated, and reſolved by deſcending diatonically upon one of the conſonances of the ſubſequent chord. The ſenſible note alone can be reſolved in aſcending; but it is even neceſſary that this ſenſible note ſhould be in the chord of the tonic dominant. As to the diſſonances which are found in the primitive chord, they ſhould always follow the common rules. (See art. 202.)

(PPP) Several muſicians call this laſt chord the *chord of the ninth*; and that which, with M. Rameau, we have ſimply called a *chord of the ninth*, they term a *chord of the ninth and ſeventh*. This laſt chord they mark with a $\frac{9}{7}$; but the denomination and figure uſed by M. Rameau are more ſimple, and can lead to no error; becauſe the chord of the ninth always includes the ſeventh, except in the caſes of which we have already ſpoken.

(QQQ) They often remove ſome diſſonances from chords of ſuppoſition, either to ſoften the harſhneſs of the chord, or to remove diſcords which can neither be prepared nor reſolved. For inſtance, let us ſuppoſe, that in the continued baſs the note *ut* is preceded by the ſenſible note *ſi*, carrying the chord of the falſe fifth, and that we ſhould chooſe to form upon this note *ut* the chord *ut mi ſol ſi re*, we muſt obliterate the ſeventh *ſi*, becauſe in retaining it we ſhould deſtroy the effect of the ſenſible note *ſi*, which ought to riſe to *ut*.

In the ſame manner, if to the harmony of a tonic dominant *ſol ſi re fa*, one ſhould add the note by ſuppoſition *ut*, it is uſual to retrench from this chord the ſenſible note *ſi*; becauſe, as the *re* ought to deſcend diatonically to *ut*, and the *ſi* to riſe to it, the effect of the one would deſtroy that of the other. This above all takes place in the *ſuſpence*, concerning which we ſhall preſently treat.

(RRR) *Suppoſition* produces what we call *ſuſpence*; and which is almoſt the ſame thing. Suſpenſion conſiſts in retaining as many as poſſible of the ſounds in a preceding chord, that they may be heard in the chord which ſucceeds. For inſtance, if this fundamental baſs be given *ut* ^{7}*ſol ut*, and this continued baſs above it $^{\sharp 7}$*ut ut ut*, it is a ſuppoſition; but if we have this fundamental baſs *ut* ^{7}*ſol* ^{7}*ſol ut*, and this continued baſs above it $^{7\ \sharp 7}$*ut ſol ut ut*, it is a ſuſpenſe; becauſe the perfect chord of *ut*, which we naturally expect after *ſol* in the continued baſs, is *ſuſpended* and *retarded* by the chord $^{\sharp 7}$*ut*, which is formed by retaining the ſounds *ſol ſi re fa* of the preceding chord to join them to the note *ut* in this manner, *ut ſol ſi re fa*; but this chord $^{\sharp 7}$*ut* does nothing in this caſe but *ſuſpend* for a moment the perfect chord *ut mi ſol ut*, which ought to follow it.

(SSS) The chord of the diminiſhed ſeventh, ſuch as *ſol♯ ſi re fa*, and the three derived from it, are termed *chords of ſubſtitution*. They are in general harſh, and proper for imitating melancholy objects.

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mi ſol♯ ſi re; that is to ſay, that it will be neceſſary to add to the chord *ſol♯ ſi re fa*, the notes *ut* or *la*, which are the third or fifth below *mi*, and which will produce,

1. By adding *ut*, the chord *ut ſol♯ ſi re fa*, compoſed of a fifth redundant, a ſeventh, a ninth, and eleventh, which is the octave of the fourth. It is called a *chord of the fifth redundant and fourth*, and thus marked $^{+5}_{4}$, or $\sharp^{5}_{4}$. (See LXXXVI.)

2. By adding *la*, we ſhall have the chord *la ſol♯ ſi re fa*, compoſed of a ſeventh redundant, a ninth, an eleventh, and a thirteenth minor, which is the octave of the ſixth minor. It is called the *chord of the ſeventh redundant and ſixth minor*, and marked $\flat 6^{7}$, or $\sharp^{7}\flat$. (See LXXXVII.) It is of all chords the moſt harſh, and the moſt rarely practiſed (TTT).

In the *Treatiſe of Harmony* by M. Rameau, and elſewhere, may be ſeen a much longer detail of the chords by ſuppoſition: But here we delineate the elements alone.

CHAP. X. *Of ſome Licences uſed in the Treble and Continued Baſs.*

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Licence 1ſt. 224. SOMETIMES in a treble, the diſſonance which ought to have been reſolved by deſcending diatonically upon the ſucceeding note, inſtead of deſcending, on the contrary riſes diatonically: but in that caſe, the note upon which it ought to have deſcended muſt be found in ſome of the other parts. This licence ought to be rarely practiſed.

In like manner, in a continued baſs, the diſſonance in a chord of the ſub-dominant inverted, as *la* in the chord *la ut mi ſol*, inverted from *ut mi ſol la*, may ſometimes deſcend diatonically inſtead of riſing as it ought to do, art. 129. n° 2.; but in that caſe the note ought to be repeated in another part, that the diſſonance may be there reſolved in aſcending.

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Licence 2d. 225. Sometimes likewiſe, to render a continued baſs more agreeable by cauſing it to proceed diatonically, they place between two ſounds of that baſs a note which belongs to the chord of neither. See example XCIV, in which the fundamental baſs *ſol ut* produces the continued baſs *ſol la ſi ſol ut*, where *la* is added on account of the diatonic modulation. This *la* has a line drawn above it to ſhow its reſolution by paſſing under the chord *ſol ſi re fa*.

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In the ſame manner, (ſee XCV), this fundamental baſs *ut fa* may produce the continued baſs *ut re mi ut fa*, where the note *re* which is added paſſes under the chord *ut mi ſol ut*.

CHAP. XI. *Containing the Method of finding the Fundamental Baſs when the Continued Baſs is figured.*

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How to find the fundamental baſs when the continued is figured.

226. To exerciſe yourſelf with greater eaſe in finding the fundamental baſs, and to render it more familiar to you, it is neceſſary to obſerve how eminent maſters, and above all how M. Rameau has put the rules in practice. Now, as they never place any thing but the continued baſs in their works, it becomes then neceſſary to know how to find the fundamental baſs when the continued baſs is figured. This problem may be eaſily ſolved by the following rules.

227. 1. Every note which has no figure in the continued baſs, ought to be the ſame, and without a figure in the fundamental baſs; it either is a tonic, or reckoned ſuch, (UUU).

2. Every note which in the continued baſs carries a 6, ought in the fundamental baſs to give its third below not figured *, or its fifth below marked with a 7. We ſhall diſtinguiſh theſe two caſes below. (See LVI. and LXIV, and the note ZZZ). * See Figured.

3. Every note carrying $^{6}_{4}$ gives in the fundamental baſs its fifth below not figured. (See LVII.)

4. Every note figured with a 7 or a ♯, is the ſame in both baſſes, and with the ſame figure (XXX).

5. Every note figured with a 2 gives in the fundamental baſs the diatonic note above figured with a 7. See LXII. (YYY).

6. Every note marked with a 4 gives in the fundamental

(TTT) As the chord of the diminiſhed ſeventh *ſol♯ ſi re fa*, and the chord of the tonic dominant *mi ſol♯ ſi re*, only differ one from the other by the notes *mi* and *fa*; one may form a diatonic modulation of theſe two notes, and then the fundamental baſs does nothing but paſs from the tonic dominant to the ſenſible note, and from that note to the tonic dominant, till it arrives at the tonic. (See XCII.)

For the ſame reaſon, as the chord of the diminiſhed ſeventh *ſol♯ ſi re fa*, and the chord *ſi re fa la*, which carries the fifth *ſi* of the tonic dominant *mi*, only differs by the ſenſible note *ſol♯*, and the tonic *la*; one may ſometimes, while the treble modulates *ſol♯ la ſol♯ la ſol♯ la*, aſcend in the fundamental baſs, from the baſs note to the third above, provided one deſcend at laſt from thence to the tonic dominant, and from thence to the tonic; (ſee XCIII.) As to what remains, this and the preceding examples are licences.

(UUU) I ſay a tonic, or *reekoned ſuch*, becauſe it may perhaps be a dominant from which the diſſonance has been removed. But in that caſe one may know that it is a real dominant by the note which precedes it. For inſtance, if the note *ſol*, carrying a perfect chord, is preceded by *re* a ſimple dominant, carrying the chord *re fa la ut*, that note *ſol* is not a real tonic; becauſe, in order to this, it would have been neceſſary that *re* ſhould have been a tonic dominant, and ſhould have carried the chord *re fa♯ la ut*; and that a ſimple dominant, as *re*, carrying the chord *re fa la ut*, ſhould only naturally deſcend to a dominant, (art. 194.)

(XXX Sometimes a note which carries a 7 in the continued baſs, gives in the fundamental baſs its third above, figured with a 6. For example, this continued baſs $la^{7}\ ſi^{8}\ ut$ gives this fundamental baſs $ut^{6}\ ſol^{7}\ ut$; but in this caſe it is neceſſary that the note figured with a 6 ſhould riſe by a fifth, as we ſee here *ut* riſe to *ſol*.

(YYY) A note figured with a 2, gives likewiſe ſometimes in the fundamental baſs its fourth above, figured with

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mental baſs the diatonic note above, figured with a 7. (See LXI.)

7. Every note figured with an 8 gives its third below figured with a 7. (See LVIII.)

8. Every note marked with a ♢ gives the fifth below marked with a 7; (ſee LX.) and it is plain by art. 187, that in the chord of the ſeventh, of which we treat in theſe three laſt articles, the third ought to be major, and the ſeventh minor, this chord of the ſeventh being the chord of the tonic dominant. (See art. 102.)

9. Every note marked with a 9 gives its third above figured with a 7. (See LXXVII and LXXIX.)

10. Every note marked with a $\frac{9}{4}$ gives the fifth above figured with a 7. (See LXXVIII.)

11. Every note marked with a $\frac{7}{5}$, or with a +5, gives the third above figured with a $\frac{7}{\sharp}$. (See LXXXI.)

12. Every note marked with a $\frac{7}{\sharp}$ gives a fifth above figured with a 7, or with a $\frac{7}{\sharp}$. (See LXXVI.) It is the ſame caſe with the notes marked $\frac{7}{4}$, $\frac{5}{4}$, or $\frac{5}{2}$: which ſhows a retrenchment, either in the complete chord of the eleventh, or in that of the ſeventh redundant.

13. Every note marked with a 4 gives a fifth above figured with a 7, or a $\frac{7}{\sharp}$. (See LXXX.)

14. Every note marked with a $\frac{9}{8}$ gives the third minor below, figured with a $\frac{7}{\flat}$. (See LXXXIII.)

15. Every note marked with a $\frac{4}{\flat}$ gives the tritone above figured with a $\frac{7}{\flat}$. (See LXXXIV.)

16. Every note marked with a +2 gives the ſecond redundant above, figured with a $\frac{7}{\flat}$. (See LXXXV.)

17. Every note marked with a $\frac{5}{4}$ gives the fifth redundant above, figured with a $\frac{7}{\flat}$. (See LXXXVI.)

18. Every note marked with a $\frac{7}{\flat 6}$ gives the ſeventh redundant above, figured with a $\frac{7}{\flat}$. See LXXXVII. (zzz).

REMARK.

228. We have omitted two caſes, which may cauſe ſome uncertainty. 270 A difficulty in finding the fundamental baſs.

The firſt is that where the note of the continued baſs is figured with a 6. We now preſent the reaſon of the difficulty.

Suppoſe we ſhould have the dominant $\frac{7}{re}$ in the fundamental baſs, the note which anſwers to it in the continued baſs may be *la* carrying the figure 6 (ſee LXIV.); that is to ſay, the chord *la ut re fa:* now if we ſhould have the ſub-dominant $\frac{6}{fa}$ in the fundamental

7

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with a 6; but it is neceſſary in that caſe that the note figured with a 6, may even here riſe to a fifth. (See note xxx).

Theſe variations in the fundamental baſs, as well in the chord concerning which we now treat, as in the chord figured with a 7, and in two others which ſhall afterwards be mentioned (art. 228 and 229), are cauſed by a deficiency in the ſigns proper for the chord of the ſub-dominant, and for the different arrangements by which it is inverted.

M. l'Abbe Rouſſier, to redreſs this deficiency, had invented a new manner of figuring the continued baſs. His method is moſt ſimple for thoſe who know the fundamental baſs. It conſiſts in expreſſing each chord by only ſignifying the fundamental ſound with that letter of the ſcale by which it is denominated, to which is joined a 7 or $\frac{7}{\flat}$, or a 6, in order to mark all the diſcords. Thus the fundamental chord of the ſeventh *re fa la ut* is expreſſed by a $\frac{7}{D}$; and the ſame chord, when it is inverted from that of the ſub-dominant *fa la ut re*, is characterized by $\frac{6}{F}$; the chord of the ſecond *ut re fa la*, inverted from the dominant *re fa la ut*, is likewiſe repreſented by $\frac{7}{D}$; and the ſame chord *ut re fa la* inverted from that of the ſub-dominant *fa la ut re* is ſignified by $\frac{6}{F}$; the caſe is the ſame when the chords are differently inverted. By this means it would be impoſſible to miſtake either with reſpect to the fundamental baſs of a chord, or with reſpect to the note which forms its diſſonance, or with reſpect to the nature and ſpecies of that diſcord.

(zzz) We may only add, that here and in the preceding articles, we ſuppoſe, that the continued baſs is figured in the manner of M. Rameau. For it is proper to obſerve, that there are not, perhaps, two muſicians who characteriſe their chords with the ſame figures; which produces a great inconveniency to the perſon who plays the accompaniments: but here we do not treat of accompaniments. For every reaſon, then, we ſhould adviſe initiates to prefer the continued baſſes of M. Rameau to all the others, as by them they will moſt ſucceſsfully ſtudy the fundamental baſs.

It is even neceſſary to advertiſe the reader, and I have already done it (note EEE), that M. Rameau only marks the leſſer ſixth by a 6 without a line, when this leſſer ſixth does not reſult from the chord of the tonic dominant; in ſuch a manner that the 6 renders it uncertain whether in the fundamental baſs we ought to chooſe the third or the fifth below: but it will be eaſy to ſee whether the third or the fifth is ſignified by that figure. This may be diſtinguiſhed, 1. In obſerving which of the two notes is excluded by the rules of the fundamental baſs. 2. If the two notes may with equal propriety be placed in the fundamental baſs, the preference muſt be determined by the tone or mode of the treble in that particular paſſage. In the following chapter we ſhall give rules for determining the mode.

There is a chord of which we have not ſpoken in this enumeration, and which is called the *chord of the ſixth redundant*. This chord is compoſed of a note, of its third major, of its redundant fourth or tritone, and its redundant ſixth, as *fa la ſi re*♯. It is marked with a 6♯. It appears difficult to find a fundamental baſs for this chord; nor is it indeed much in uſe amongſt us. (See the note upon the art. 115.)

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mental baſs, this ſub-dominant might produce in the continued baſs the ſame note *la* figured with a 6. When therefore one finds in the continued baſs a note marked with a 6, it appears at firſt uncertain whether we ſhould place in the fundamental baſs the fifth below marked with a 7, or the third below marked with a 6.

271 Another.

229. The ſecond caſe is that in which the continued baſs is figured with a $\frac{6}{5}$. For inſtance, if there ſhould be found $\frac{6}{5}$ *fa* in the continued baſs, one may be ignorant whether he ought to inſert in the fundamental baſs *fa* marked with a 6, or *re* figured with a 7.

272 Solution.

230. You may eaſily extricate yourſelf from this little difficulty, in leaving for an inſtant this uncertain note in ſuſpence, and in examining what is the ſucceeding note of the fundamental baſs; for if that note be in the preſent caſe a fifth above *fa*, that is to ſay, if it is *ut*, in this caſe, and in this alone, he may place $\frac{6}{5}$ *fa* in the fundamental baſs. It is a conſequence of this rule, that in the fundamental baſs every ſub-dominant ought to riſe by a fifth (195).

CHAP. XII. *What is meant by being in a Mode or Tone.*

273 Method of determining the mode in which we are.

231. IN the firſt part of this treatiſe (chap. vi), we have explained, how by the means of the note *ut*, and of its two fifths *ſol* and *fa*, one in aſcending, which is called a *tonic dominant*, the other in deſcending, which is called a *ſub-dominant*, the ſcale *ut re mi fa ſol la ſi ut* may be found: the different ſounds which form this ſcale compoſe what we call the *major mode* of *ut*, becauſe the third *mi* above *ut* is major. If therefore we would have a modulation in the major mode of *ut*, no other ſounds muſt enter into it than thoſe which compoſe this ſcale; in ſuch a manner that if, for inſtance, I ſhould find *fa*♯ in this modulation, this *fa*♯ diſcovers to me that I am not in the mode of *ut*, or at leaſt that, if I have been in it, I am no longer ſo.

232. In the ſame manner, if I form this ſcale in aſcending *la ſi ut*♯ *re mi fa*♯ *ſol*♯ *la*, which is exactly ſimilar to the ſcale *ut re mi fa ſol la ſi ut* of the major mode of *ut*, this ſcale, in which the third from *la* to *ut*♯ is major, ſhall be in the major mode of *la*; and if I incline to be in the minor mode of *la*, I have nothing to do but to ſubſtitute for *ut* ſharp *ut* natural; ſo that the major third *la ut*♯ may become minor *la ut*; I ſhall have then

la ſi ut re mi fa♯ *ſol*♯ *la*,

which is (85) the ſcale of the minor mode of *la* in aſcending; and the ſcale of the minor mode of *la* in deſcending ſhall be (90)

la ſol fa mi ut re ſi la,

in which the *ſol* and *fa* are no longer ſharp. For it is a ſingularity peculiar to the minor mode, that its ſcale is not the ſame in riſing as in deſcending (89).

274 Hence it appears what ſharps and flats ſhould be placed at the cleff in the major mode of *la*, and why they are omitted in the minor mode in deſcending.

233. This is the reaſon why, when we wiſh to begin a piece in the major mode of *la*, we place three ſharps at the cleff upon *fa*, *ut*, and *ſol*; and on the contrary, in the minor mode of *la*, we place none, becauſe the minor mode of *la*, in deſcending, has neither ſharps nor flats.

234. As the ſcale contains twelve ſounds, each diſtant from the other by the interval of a ſemitone, it is obvious that each of theſe ſounds can produce both a major and a minor mode, which conſtitute 24 modes upon the whole. Of theſe we ſhall immediately give a table, which may be very uſeful to diſcover the mode in which we are.

275 Modes 24 in the whole.

A TABLE of the DIFFERENT MODES.

Major Modes.

Maj Mode.	
of *ut*	*ut re mi fa ſol la ſi ut.*
of *ſol*	*ſol la ſi ut re mi fa*♯ *ſol.*
of *re*	*re mi fa*♯ *ſol la ſi ut*♯ *re.*
of *la*	*la ſi ut*♯ *re mi fa*♯ *ſol*♯ *la.*
of *mi*	*mi fa*♯ *ſol*♯ *la ſi ut*♯ *re*♯ *mi.*
of *ſi*	*ſi ut*♯ *re*♯ *mi fa*♯ *ſol*♯ *la*♯ *ſi.*
of *fa*♯	*fa*♯ *ſol*♯ *ſi ut*♯ *re*♯ *mi*♯ *fa*♯ (AAAA).
of *ut*♯ or *re*♭	*re*♭ *mi*♭ *fa ſol*♭ *la*♭ *ſi*♭ *ut re*♭.
of *ſol*♯ or *la*♭	*la*♭ *ſi*♭ *ut re*♭ *mi*♭ *fa ſol la*♭.
of *re*♯ or *mi*♭	*mi*♭ *fa ſol la*♭ *ſi*♭ *ut re mi*♭.

(AAAA) The major mode of *fa*♯, of *ut*♭ or *re*♯, and of *ſol*♯ or *la*♭, are not much practiſed. In the opera of *Pyramus* and *Thiſbe*, p. 267, there is a paſſage in the ſcene, of which one part is in the major mode of *fa*♯, and the other in the major mode of *ut*♯, and there are ſix ſharps at the cleff.

When a piece begins upon *ut*♯, there ought to be ſeven ſharps placed at the cleff: but it is more convenient only to place five flats, and to ſuppoſe the key *re*♭, which is almoſt the ſame thing with *ut*♯. It is for this reaſon that we ſubſtitute here the mode of *re*♭ for that of *ut*♯.

It is ſtill much more neceſſary to ſubſtitute the mode of *la*♭ for that of *ſol*♯; for the ſcale of the major mode of *ſol* is

ſol♯, *la*♯, *ſi*♯, *ut*♯, *re*♯, *mi*♯, *ſol*, *ſol*♯,

in which you may ſee that there are at the ſame time both a *ſol* natural and a *ſol*♯: it would then be neceſſary, even at the ſame time, that upon *ſol* there ſhould and ſhould not be a ſharp at the cleff; which is ſhocking and inconſiſtent. It is true that this inconvenience may be avoided by placing a ſharp upon *ſol* at the cleff, and by marking the note *ſol* with a natural through the courſe of the muſic wherever it ought to be natural; but this would become troubleſome, above all if there ſhould be occaſion to tranſpoſe. In the article 236, we ſhall give an account of tranſpoſition. One might likewiſe in this ſeries, inſtead of *ſol* natural, which is the note immediately before the laſt, ſubſtitute *fa*♯♯, that is to ſay, *fa* twice ſharp: which, however, is not abſolutely the ſame ſound with *ſol* natural, eſpecially upon inſtruments whoſe ſcales are fixed, or whoſe intervals are invariable. But in that caſe two ſharps may be placed at the cleff upon *fa*, which would produce another inconvenience. But by ſubſtituting *la*♭ for *ſol*♯, the trouble is eluded.

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of *la*♯ or *si*♭ } *si*♭ *ut re mi*♭ *fa sol la si.*
of *mi*♯ or *fa*♭ } *fa sol la si*♭ *ut re mi fa.*
of *si*♯ or *ut*♭ } *ut re mi fa sol la si ut.*

Minor Modes.

Of *la.*

In deſcending. *la ſol fa mi re ut ſi la.*
In riſing. *la ſi ut re mi fa*♯ *ſol*♯ *la.*

Of *mi.*

In deſcending. *mi re ut ſi la ſol fa*♯ *mi.*
In riſing. *mi fa*♯ *ſol la ſi ut*♯ *re*♯ *mi.*

Of *ſi.*

In deſcending. *ſi la ſol fa*♯ *mi re ut*♯ *ſi.*
In riſing. *ſi ut*♯ *re mi fa*♯ *ſol*♯ *la*♯ *ſi.*

Of *fa*♯.

In deſcending. *fa*♯ *mi re ut*♯ *ſi la ſol*♯ *fa.*
In riſing. *fa*♯ *ſol*♯ *la ſi ut*♯ *re*♯ *mi*♯ *fa*♯.

Of *ut*♯

In deſcending. *ut ſi la ſol*♯ *fa*♯ *mi re*♯ *ut*♯.
In riſing. *ut*♯ *re*♯ *mi fa*♯ *ſol*♯ *la*♯ *ſi*♯ *ut*♯.

Of *ſol*♯ or *lab.*

In deſcending. *ſol*♯ *fa*♯ *mi ut*♯ *ſi la*♯ *ſol*♯.
In riſing. *lab ſib ut*♭ *reb mib fa ſol lab.*

Of *re*♯ or *mib.*

In deſcending. *mib reb ut*♭ *ſib lab ſol*♭ *fa mib.*
In riſing. *mib fa ſol*♭ *lab ſib ut re mib.*

Of *la*♯ or *ſib.*

In deſcending. *ſib lab, ſol*♭ *fa mib reb ut ſib.*
In riſing. *ſib ut reb mib fa ſol la ſib.*

Of *mi*♯ or *fa*♭.

In deſcending. *fa mib reb ut ſib lab ſol fa.*
In riſing. *fa ſol lab ſib ut re mi fa.*

Of *ut.*

In deſcending. *ut ſib lab ſol fa mib re ut.*
In riſing. *ut re mib fa ſol la ſi ut.*

Of *ſol.*

In deſcending. *ſol fa mib re ut ſib la ſol.*
In riſing. *ſol la ſib ut re mi fa*♯ *ſol.*

Of *re.*

In deſcending. *re ut ſib la ſol fa mi re.*
In riſing. *re mi fa ſol la ſi ut*♯ *re* (BBBB.)

276 Modes crowded with ſharps and flats little practiſed.

235. Theſe then are all the modes, as well major as minor. Thoſe which are crowded with ſharps and flats are little practiſed, as being extremely difficult in execution.

236. From thence it follows,

277 Reſults.

1. That when there are neither ſharps nor flats at the cleff, it is a token that the piece begins in the major mode of *ut*, or in the minor mode of *la*.

2. That when there is one ſingle ſharp, it will always be placed upon *fa*, and that the piece begins in the major mode of *ſol*, or the minor of *mi*, in ſuch a manner that it may be ſung as if there were no ſharp, by ſinging *ſi* inſtead of *fa*♯, and in ſinging the tune as if it had been in another cleff. For inſtance, let there be a ſharp upon *fa* in the cleff of *ſol* upon the firſt line; one may then ſing the tune as if there were no ſharp: And inſtead of the cleff of *ſol* upon the firſt line, let there be the cleff of *ut*; for the *fa*♯, when changed into *ſi*, will require that the cleff of *ſol* ſhould be changed to the cleff of *ut*, as may be eaſily ſeen. This is what we call *tranſpoſition* (‡).

See *Tranſpoſition.*

278 All the modes reducible to the major of *ut* and the minor of *la*.

237. It is evident, that when *fa*♯ is changed into *ſi*, *ſol* muſt be changed into *ut*, and *mi* into *la*. Thus by tranſpoſition, the air has the ſame melody as if it were in the major mode of *ut*, or in the minor mode of *la*.

(BBBB) We have already ſeen, that in each mode, the principal note is called a *tonic*; that the fifth above that note is called a *tonic dominant*, or the *dominant of the mode*, or ſimply a *dominant*; that the fifth beneath the tonic, or, what is the ſame thing, the fourth above that tonic, is called a *ſub-dominant*; and in ſhort, that the note which forms a ſemitone beneath the tonic, and which is a third major from the dominant, is called a *ſenſible note*. The other notes have likewiſe in every mode particular names which it is advantageous to know. Thus a note which is a tone immediately above the tonic, as *re* in the mode of *ut*, and *ſi* in that of *la*, is termed a *ſub-tonic*; the following note, which is a third major or minor from the tonic, according as the chord is major or minor, ſuch as *mi* in the major mode of *ut*, and *ut* in the minor mode of *la*, is called a *mediant*; in ſhort, the note which is a tone above the dominant, ſuch as *la* in the mode of *ut*, and *fa*♯ in that of *la*, is called a *ſub-dominant*.

‡ Though our author's account of this delicate operation in muſic will be found extremely juſt and compendious; though it proceeds upon ſimple principles, and comprehends every poſſible contingency; yet as the manner of thinking upon which it depends may be leſs familiar to Engliſh readers, if not profoundly ſkilled in muſic, it has been thought proper to give a more familiar, though leſs comprehenſive, explanation of the manner in which *tranſpoſition* may be executed.

It will eaſily occur to every reader, that if each of the intervals through the whole diatonic ſeries were equal, in a mathematical ſenſe, it would be abſolutely indifferent upon what note any air were begun, if within the compaſs of the gammut; becauſe the ſame equal intervals muſt always have the ſame effects. But ſince, beſides the natural ſemitones, there is another diſtinction of diatonic intervals into *greater* and *leſſer tones*; and ſince theſe vary their poſitions in the ſeries of an octave, according as the note from whence you begin is placed, that note is conſequently the beſt key for any tune whoſe natural ſeries is moſt exactly correſpondent with the intervals which that melody or harmony requires. But in inſtruments whoſe ſcales are fixed, notwithſtanding the temperament and other expedients of the ſame kind, ſuch a ſeries is far from being eaſily found, and is indeed in common practice almoſt totally neglected. All that can frequently be done is, to take care that the ear may not be ſenſibly ſhocked. This, however, would be the caſe, if, in tranſpoſing any tune, the ſituation of the ſemitones, whether natural or artificial, were not exactly correſpondent in the ſeries to which your air muſt be tranſpoſed, with their poſitions in the ſcale from which you tranſpoſe it. Suppoſe

for

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of *la*. The major mode then of *ſol*, and the minor of *mi*, are by tranſpoſition reduced to thoſe of *ut* major, and of *la* minor. It is the ſame caſe with all the other modes, as any one may eaſily be convinced (cccc).

CHAP. XIII. *To find the Fundamental Baſs of a given Modulation.*

238. As we have reduced to a very ſmall number of rules the fundamental baſs, and thoſe which in the treble ought to be obſerved with relation to this baſs, it ſhould no longer be difficult to find the fundamental baſs of a given modulation, nay, frequently to find ſeveral; for every fundamental baſs will be legitimate, when it is formed according to the rules which we have given (Chap. VI.); and that, beſides this, the diſſonances which the modulation may form with this

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279 Method of finding a fundamental baſs to a given air not difficult, and why.

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for inſtance, your air ſhould begin upon *ut* or C, requiring the natural diatonic ſeries through the whole gammut, in which the diſtance between *mi* and *fa*, or E and F, as alſo that between *ſi* and *ut*, or B and C, is only a ſemitone. Again, ſuppoſe it neceſſary for your voice, or the inſtrument on which you play, that the ſame air ſhould be tranſpoſed to *ſol* or G, a fifth above its former key; then becauſe in the firſt ſeries the intervals between the third and the fourth, ſeventh and eighth notes, are no more than ſemitones, the ſame intervals muſt take the ſame place in the octave to which you tranſpoſe. Now, from *ſol* or G, the note with which you propoſe to begin, the three tones immediately ſucceeding are full; but the fourth, *ut* or C, is only a ſemitone; it may therefore be kept in its place. But from *fa* or F, the ſeventh note above, to *ſol* or G, the eighth, the interval is a full tone, which muſt conſequently be redreſſed by raiſing your *fa* a ſemitone higher. Thus the ſituations of the ſemitonic intervals in both octaves will be correſpondent; and thus, by conforming the poſitions of the ſemitones in the octave to which you tranſpoſe, with thoſe in the octave in which the original key of the tune is contained, you will perform your operation with as much ſucceſs as the nature of fixed ſcales can admit: But the order in which you muſt proceed, and the intervals required in every mode, are minutely and ingeniouſly delineated by our author.

(cccc) Two ſharps, *fa*♯ and *ut*♯, indicate the major mode of *re*, or the minor of *ſi*; and then, by tranſpoſition, the *ut*♯ is changed into *ſi*, and of conſequence, *re* into *ut* and *ſi* into *la*.

Three ſharps, *fa*♯ *ut*♯ *ſol*♯ indicate the major mode of *la*, or the minor of *fa*♯; and it is then *ſol*♯, which muſt be changed into *ſi*, and of conſequence *la* into *ut*, and *fa*♯ into *la*.

Four ſharps, *fa*♯ *ut*♯ *ſol*♯ *re*♯, indicate the major mode of *mi*, or the minor of *ut*♯; then the *re*♯ is changed into *ſi*, and of conſequence *mi* into *ut*, and *ut*♯ into *la*.

Five ſharps, *fa*♯ *ut*♯ *ſol*♯ *re*♯ *la*♯, indicate the major mode of *ſi*, or the minor of *ſol*♯; *la* then is changed into *ſi*, and of conſequence *ſi* into *ut*, and *ſol*♯ into *la*.

Six ſharps, *fa*♯ *ut*♯ *ſol*♯ *re*♯ *la*♯ *mi*♯, indicate the major mode of *fa*♯; *mi*♯ then is changed into *ſi*, and of conſequence *fa*♯ into *ut*.

Six flats, *ſi*♭ *mi*♭ *la*♭ *re*♭ *ſol*♭ *ut*♭, indicate the minor mode of *mi*♭; *ut* is changed into *fa*, and of conſequence *mi*♭ into *la*.

Five flats, *ſi*♭ *mi*♭ *la*♭ *re*♭ *ſol*♭, indicate the major mode of *re*♭, or the minor mode of *ſi*♭; then the *ſi*♭ is changed into *fa*, and of conſequence the *re*♭ into *ut*, and the *ſi*♭ into *la*.

Four flats, *ſi*♭ *mi*♭ *la*♭ *re*♭, indicate the major mode of *la*♭, or the minor mode of *fa*; *re*♭ then is changed into *fa*, and of conſequence *la*♭ into *ut*, and *fa* into *la*.

Three flats, *ſi*♭ *mi*♭ *la*♭, indicate the major mode of *mi*♭, or the minor of *ut*; the *la*♭ then is changed into *fa*, and of conſequence *mi*♭ into *ut*, and the *ſol* into *la*.

Two flats, *ſi*♭ *mi*♭, indicate the major mode of *ſi*♭, or the minor of *ſol*; *mi*♭ then is changed into *fa*, and of conſequence *ſi*♭ into *ut*, and the *fa* into *la*.

One flat, *ſi*♭, indicates the major mode of *fa*, or the minor mode of *re*, and *ſi*♭ is changed into *fa*; of conſequence the *fa* is changed into *ut*, and the *re* into *la*.

All the major modes then may be reduced to that of *ut*, and the modes minor to that of *la* minor.

It only remains to remark, that many muſicians, and amongſt others the ancient muſicians of France, as Lulli, Campra, &c. place one flat leſs in the minor mode: ſo that in the minor mode of *re*, they place neither ſharp nor flat at the cleff; in the minor mode of *ſol*, one flat only; in the minor mode of *ut*, two flats, &c.

This practice in itſelf is ſufficiently indifferent, and ſcarcely merits the trouble of a diſpute. Yet the method which we have here deſcribed, according to M. Rameau, has the advantage of reducing all the modes to two; and beſides it is founded upon this ſimple and very general rule, That in the major mode, we muſt place as many ſharps or flats at the cleff, as are contained in the diatonic ſcale of that mode in aſcending; and in the minor mode, as many as are contained in that ſame ſcale in deſcending.

However this be, I here preſent you with a rule for tranſpoſition, which appears to me more ſimple than the rule in common uſe.

For the Sharps.

Suppoſe *ſol*, *re*, *la*, *mi*, *ſi*, *fa*, and change *ſol* into *ut* if there is one ſharp at the cleff, *re* into *ut* if there are two ſharps, *la* into *ut* if there are three, &c.

For the Flats.

Suppoſe *fa*, *ſi*, *mi*, *la*, *re*, *ſol*, and change *fa* into *ut* if there is only one flat at the cleff, *ſi* into *ut* if there are two flats, *mi* into *ut* if there are three, &c.

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this baſs, will both be prepared, if it is neceſſary that they ſhould be ſo, and always reſolved (DDDD).

239. It is of the greateſt utility in ſearching for the fundamental baſs, to know what is the tone or mode of the melody to which that baſs ſhould correſpond.

280 Difficulty of aſſigning general rules for aſcertaining the mode of a melody whoſe fundamental baſs is ſought.

—But it is difficult in this matter to aſſign general rules, and ſuch as are abſolutely without exception, in which nothing may be left that appears indifferent or diſcretionary; becauſe ſometimes we ſeem to have the free choice of referring a particular melody either to one mode or another. For example, this melody *ſol ut* may belong to all the modes, as well major as minor, in which *ſol* and *ut* are found together; and each of theſe two ſounds may even be conſidered as belonging to a different mode.

281 Reaſons why one may proceed without the knowledge of the mode, and how he may be preſerved from deviating in compoſition.

240. For what remains, one may ſometimes, as it ſhould ſeem, operate without the knowledge of the mode, for two reaſons: 1. Becauſe, ſince the ſame ſounds belong to ſeveral different modes, the mode is ſometimes conſiderably undetermined; above all, in the middle of a piece, and during the time of one or two bars. 2. Without giving ourſelves much trouble about the mode, it is often ſufficient to preſerve us from deviating in compoſition, if we obſerve in the ſimpleſt manner the rules above preſcribed (ch. VI.) for the procedure of the fundamental baſs.

282 Knowledge of the mode in beginning a piece indiſpenſable, and why.

241. In the mean time, it is above all things neceſſary to know in what mode we operate at the beginning of the piece, becauſe it is indiſpenſable that the fundamental baſs ſhould begin in the ſame mode, and that the treble and baſs ſhould likewiſe end in it; nay, that they ſhould even terminate in its fundamental note, which in the mode of *ut* is *ut*, and *la* in that of *la*, &c. Beſides, in thoſe paſſages of the modulation where there is a cadence, it is generally neceſſary that the mode of the fundamental baſs ſhould be the ſame with that of the part to which it correſponds.

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283 Inveſtigation of the mode continued.

242. To know upon what mode or in what key a piece commences, our inquiry may be entirely reduced to diſtinguiſh the major mode of *ut* from the minor of *la*. For we have already ſeen (art. 236. and 237.), that all the modes may be reduced to theſe two, at leaſt in the beginning of the piece. We ſhall now therefore give a detail of the different means by which theſe two modes may be diſtinguiſhed.

284 Means by which the modes may be determined.

1. From the principal and characteriſtical ſounds of the mode, which are *ut mi ſol* in the one, and *la ut mi* in the other; ſo that if a piece ſhould, for inſtance, begin thus, *la ut mi la*, it may be almoſt conſtantly concluded, that the tone or mode is in *la* minor, although the notes *la ut mi* belong to the mode of *ut*.

2. From the ſenſible note, which is *ſi* in the one, and *ſol*♯ in the other; ſo that if *ſol*♯ appears in the firſt bars of a piece, one may be certain that he is in the mode of *la*.

3. From the adjuncts of the mode, that is to ſay, the modes of its two fifths, which for *ut* are *fa* and *ſol*, and *re* and *mi* for *la*. For example, if after having begun

(DDDD) We often ſay, *that we are upon a particular key*, inſtead of ſaying *that we are in a particular mode*. The following expreſſions therefore are ſynonymous; *ſuch a piece is in* ut *major*, or *in the mode of* ut *major*, or *in the key of* ut *major*.

We have ſeen that the diatonic ſcale or gammut of the Greeks was *la ſi ut re mi fa ſol la* (art. 49.) A method has likewiſe been invented of repreſenting each of the ſounds in this ſcale by a letter of the alphabet; *la* by A, *ſi* by B, *ut* by C, &c. It is from hence that theſe forms of ſpeaking proceed: Such a piece is upon A, *with* mi, la, *and its third minor*; or, ſimply, it is upon A, *with* mi, la, *and its minor*; ſuch another piece upon C, *with* ſol, ut, *and its third major*; or, ſimply, upon C, *with* ſol, ut, *and its major*; to ſignify that the one is the mode of *la minor*, or that the other is in that of *ut major*; this laſt manner of ſpeaking is more conciſe, and on this account it begins to become general.

They likewiſe call the cleff of *ut fa* F, the cleff of *re ſol* G, &c. to denominate the cleff of *fa*, the cleff of *ſol*, &c.

They ſay likewiſe to take the A *mi la*, to give the A *mi la*; that is to ſay, to take the uniſon of a certain note called *la* in the harpſichord, which *la* is the ſame that occupies the fifth line, or the higheſt line in the firſt cleff of *fa*. This *la* divides in the middle the two octaves which ſubſiſt (note RR) between the *ſol* which occupies the firſt line in the cleff of *ſol* upon that ſame line, and that *ſol* which occupies the firſt line in the cleff of *fa* upon the fourth; and as it poſſeſſes (if we may ſpeak ſo) the middle ſtation between the ſharpeſt and loweſt ſounds, it has been choſen to be the ſound with relation to which all the voices and inſtruments ought to be tuned in a concert (§).

(§) Thus far our author: and though the note is no more than an illuſtration of the technical phraſeology in his native language, we did not think it conſiſtent with the fidelity of a tranſlation to omit it. We have little reaſon to envy, and ſtill leſs to follow, the French in their abbreviations of ſpeech; the native energy of our tongue ſuperſedes this neceſſity in a manner ſo effectual, that, in proportion as we endeavour to become ſuccinct, our ſtyle, without the ſmalleſt ſacrifice of perſpicuity, becomes more agreeable to the genius of our language; whereas, in French, laconic diction is equally ambiguous and diſagreeable. Of this we cannot give a more flagrant inſtance than the note upon which theſe obſervations are made, in its original. We muſt, however, follow the author's example, in reciting a few technical phraſes upon the ſame ſubject, which occur in our language, and which, if we are not miſtaken, will be found equally conciſe, at the ſame time that they are more natural and intelligible. When we mean to expreſs the fundamental note of that ſeries within the diatonic octave which any piece of muſic demands, we call that note the *key*. When we intend to ſignify its mode, whether major or minor, we denominate the harmony *ſharp* or *flat*. When in a concert we mean to try how inſtruments are in tune by that note upon which, according to the genius of each particular inſtrument, they may beſt agree in uniſon, we deſire the muſicians who join us to ſound A.

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gun a melody by ſome of the notes which are common to the modes of *ut* and of *la* (as *mi re mi fa mi re ut ſi ut*), I ſhould afterwards find the mode of *ſol*, which I aſcertain by the *fa*♯, or that of *fa* which I aſcertain by the *ſi*♭ or *ut*♮, I may conclude that I have begun in the mode of *ut*; but if I find the mode of *re*, or that of *mi*, which I aſcertain by *ſi*♭, *ut*♯, or *re*♯, &c. I conclude from thence that I have begun in the mode of *la*.

4. A mode is not for ordinary deſerted, eſpecially in the beginning of a piece, but that we may paſs into one or other of theſe modes which are moſt relative to it, which are the mode of its fifth above, and that of its third below, if the original mode be major, or of its third above if it be minor. Thus, for inſtance, the modes which are moſt intimately relative to the major mode of *ut*, are the major mode of *ſol*, and that of *la* minor. From the mode of *ut* we commonly paſs either into the one or the other of theſe modes; ſo that we may ſometimes judge of the principal mode in which we are, by the relative mode which follows it, or which goes before it, when theſe relative modes are deciſively marked. For what remains, beſides theſe two relative modes, there are likewiſe two others into which the principal mode may paſs, but leſs frequently, viz. the mode of its fifth below, and that of its third above, as *fa* and *mi* for the mode of *ut* (EEEE).

5. The modes may ſtill be likewiſe diſtinguiſhed by the cadences of the melody. Theſe cadences ought to occur at the end of every two, or at moſt of every four bars, as in the fundamental baſs: now the note of the fundamental baſs which is moſt ſuitable to theſe cloſes*, is always eaſy to be found. For the ſounds which occur in the treble may be conſulted M. Rameau, p. 54. of his *Nouveau Syſteme de Muſique theorique et pratique* (FFFF).

* See *Cadence.*

285 Having aſcertained the mode, the fundamental baſs not difficult.

When a perſon is once able to aſcertain the mode, and can render himſelf ſure of it by the different means which we have pointed out, the fundamental baſs will coſt little pains. For in each mode there are three fundamental ſounds.

1. The tonic of the mode, or its principal ſound, which carries always the perfect chord major or minor, according as the mode itſelf is major or minor.

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Major mode of UT. *ut mi ſol ut.*
Minor mode of LA. *la ut mi la.*

2. The tonic dominant, which is a fifth above the tonic, and which, whether in the major or minor mode, always carries a chord of the ſeventh, compoſed of a third major followed by two thirds minor.

Tonic dominant.
Major mode of UT. *ſol ſi re fa.*
Tonic dominant.
Minor mode of LA. *mi ſol*♯ *ſi re.*

3. The ſub-dominant, which is a fifth below the tonic, and which carries a chord compoſed of a third, fifth, and ſixth major, the third being either greater or leſſer, according as the mode is major or minor.

Sub-dominant.
Major mode of UT. *fa la ut re.*
Minor mode of LA. *re fa la ſi.*

Theſe three ſounds, the tonic, the tonic dominant, and the ſub-dominant, contain in their chords all the notes which enter into the ſcale of the mode; ſo that when a melody is given, it may almoſt always be found which of theſe three ſounds ſhould be placed in the fundamental baſs, under any particular note of the upper part. Yet it ſometimes happens that not one of theſe notes can be uſed. For example, let it be ſuppoſed that we are in the mode of *ut*, and that we find in the melody theſe two notes *la ſi* in ſucceſſion; if we confine ourſelves to place in the fundamental baſs one of the three ſounds *ut ſol fa*, we ſhall find nothing for the ſounds *la* and *ſi* but this fundamental baſs $\overset{6}{fa}\ \overset{7}{ſol}$; now ſuch a ſucceſſion as $\overset{6}{fa}$ to $\overset{7}{ſol}$ is prohibited by the fifth rule for the fundamental baſs, according to which every ſub-dominant, as *fa*, ſhould riſe by a fifth; ſo that $\overset{6}{fa}$ can only be followed by *ut* in the fundamental baſs, and not by $\overset{7}{ſol}$.

To remedy this, the chord of the ſub-dominant *fa la ut re* muſt be inverted into a fundamental chord of the ſeventh, in this manner, *re fa la ut*, which has been called the *double employment* (art. 105.) becauſe it is a ſecondary manner of employing the chord of the ſub-

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(EEEE) It is certain that the minor mode of *mi* has an extremely natural connection with the mode of *ut*, as has been proven (art. 92.) both by arguments and by examples. It has likewiſe appeared in the note upon the art. 93. that the minor mode of *re* may be joined to the major mode of *ut*: and thus in a particular ſenſe, this mode may be conſidered as relative to the mode of *ut*, but it is ſtill leſs ſo than the major modes of *ſol* and *fa*, or than thoſe of *la* and *mi* minor; becauſe we cannot immediately, and without licence, paſs in a fundamental baſs from the perfect minor chord of *ut* to the perfect minor chord of *re*; and if you paſs immediately from the major mode of *ut* to the minor mode of *re* in a fundamental baſs, it is by paſſing, for inſtance, from the tonic *ut*, or from *mi ſol ut*, to the tonic dominant of *re*, carrying the chord *la ut*♯ *mi ſol*, in which there are two ſounds, *mi ſol*, which are found in the preceding chord; or otherwiſe from *ut mi ſol ut* to *ſol ſi*♭ *re mi*, a chord of the ſub-dominant in the minor mode of *re*, which chord has likewiſe two ſounds, *ſol* and *mi*, in common with that which went immediately before it.

(FFFF) All theſe different manners of diſtinguiſhing the modes ought, if we may ſpeak ſo, to give mutual light and aſſiſtance one to the other. But it often happens, that one of theſe ſigns alone is not ſufficient to determine the mode, and may even lead to error. For example, if a piece of muſic begins with theſe three notes, *mi ut ſol*, we muſt not with too much precipitation conclude from thence that we are in the major mode of *ut*, although theſe three ſounds, *mi ut ſol*, be the principal and characteriſtical ſounds in the major mode of *ut*: we may be in the minor mode of *mi*, eſpecially if the note *mi* ſhould be long. You may ſee an example in the fourth act of *Zoroaſter*, where the firſt air ſung by the prieſts of Arimanes begins thus with two times *ſol mi*♭ *ſi*♭, each of theſe notes being a crotchet. The air is in the minor mode of *ſol*, and not in the major mode of *mi*♭, as one would at firſt be tempted to believe it. Now we may be ſenſible that it is in *ſol* minor, by the relative modes which follow, and by the notes where the cadences fall.

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ſub-dominant. By theſe means we give to the modulation *la ſi*, this fundamental baſs *re ſol*, which procedure is agreeable to rules.

Here then are four chords, *ut mi ſol ut*, *ſol ſi re fa*, *fa la ut re*, *re fa la ut*, which may be employed in the major mode of *ut*. We ſhall find in like manner, for the minor mode of *la*, four chords,

la ut mi la, *mi ſol♯ ſi re*,
re fa la ſi, *ſi re fa la*.

And in this mode we ſometimes change the laſt of theſe chords into *ſi re fa♯ la*, ſubſtituting the *fa♯* for *fa♮*. For inſtance, if we have this melody in the minor mode of *la mi fa♯ ſol♯ la*, we would cauſe the firſt note *mi* to carry the perfect chord *la ut mi la*, the ſecond note *fa♯* to carry the chord of the ſeventh *ſi re fa♯ la*, the third note *ſol♯* the chord of the tonic dominant *mi ſol♯ ſi re*, and in ſhort, the laſt the perfect chord *la ut mi la*.

On the contrary, if this melody is given always in the minor mode *la la ſol♯ la*, the ſecond *la* being ſyncopated, it might have the ſame baſs as the modulation *mi fa♯ ſol♯ la*, with this difference alone, that *fa♮* might be ſubſtituted for *fa♯* in the chord *ſi re a♯ la*, the better to mark out the minor mode.

Beſides theſe chords which we have juſt mentioned, and which may be regarded as the principal chords of the mode, there are ſtill a great many others; for example, the ſeries of dominants,

ut la re ſol ut fa ſi mi la re ſol ut,

which are terminated equally in the tonic *ut*, either entirely belong, or at leaſt may be reckoned as belonging (GGGG) to the mode of *ut*; becauſe none of theſe dominants are tonic dominants, except *ſol*, which is the tonic dominant of the mode of *ut*; and beſides, becauſe the chord of each of theſe dominants forms no other ſounds than ſuch as belong to the ſcale of *ut*.

But if I were to form this fundamental baſs,

ut la re ſol ut,

conſidering the laſt *ut* as a tonic dominant in this manner, *ut mi ſol ſi♭*; the mode would then be changed at the ſecond *ut*, and we ſhould enter into the mode of *fa*, becauſe the chord *ut mi ſol ſi♭* indicates the tonic dominant of the mode of *fa*; beſides, it is evident that the mode is changed, becauſe *ſi♭* does not belong to the ſcale of *ut*.

In the ſame manner, were I to form this fundamental baſs

ut la re ſol ut,

conſidering the laſt *ut* as a tonic dominant, in this manner, *ut mi ſol la*; this laſt *ut* would indicate the mode of *ſol*, of which *ut* is the *ſub-dominant*. Principles of Compoſition.

In like manner, ſtill, if in the firſt ſeries of dominants, I cauſed the firſt *re* to carry the third major, in this manner, *re fa♯ la ut*; this *re* having become a tonic dominant, would ſignify to me the major mode of *ſol*, and the *ſol* which ſhould follow it, carrying the chord *ſi re fa*, would relapſe into the mode of *ut*, from whence we had departed.

Finally, in the ſame manner, if in this ſeries of dominants, one ſhould cauſe *ſi* to carry *fa♯* in this manner, *ſi re fa♯ la*, this *fa* would ſhow that we had departed from the mode *ut*, to enter into that of *ſol*.

From hence it is eaſy to form this rule for diſcovering the changes of mode in the fundamental baſs.

286 A rule for diſcovering the changes of mode.

1. When we find a tonic in the fundamental baſs, we are in the mode of that tonic; and the mode is major or minor, according as the perfect chord is major or minor.

2. When we find a ſub-dominant, we are in the mode of the fifth above that ſub-dominant; and the mode is major or minor, according as the third in the chord of the ſub-dominant is major or minor.

3. When we find a tonic dominant, we are in the mode of the fifth below that tonic dominant. As the tonic dominant carries always the third major, one cannot be ſecure by the aſſiſtance of this dominant alone, whether the mode be major or minor: but it is only neceſſary for the compoſer to caſt his eye upon the following note, which muſt be the tonic of the mode in which he is; by the third of this tonic he will diſcover whether the mode be major or minor.

243. Every change of the mode ſuppoſes a cadence; and when the mode changes in the fundamental baſs, it is almoſt always either after the tonic of the mode in which we have been, or after the tonic dominant of that mode, conſidered then as a tonic by favour of a cloſe which ought neceſſarily to be found in that place: Whence it happens that cadences in a melody for the moſt part preſage a change of mode which ought to follow them.

244. All theſe rules, joined with the table of modes which we have given (art. 234.), will ſerve to diſcover in what mode we are in the middle of a piece, eſpecially in the moſt eſſential paſſages, as cadences (HHHH).

I here ſubjoin the ſoliloquy of Armida, with the continued and fundamental baſſes. The changes of the mode will be eaſily diſtinguiſhed in the fundamental baſs,

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(GGGG) I have ſaid, *that they may be reckoned as belonging to this mode*, for two reaſons: 1. Becauſe, properly ſpeaking, there are only three chords which eſſentially and primitively belong to the mode of *ut*, viz. *ut* carrying the perfect chord, *fa* carrying that of the ſub-dominant, and *ſol* that of the tonic dominant, to which we may join the chord of the ſeventh, *re fa la ut* (art 105.): but we here regard *as extended* the ſeries of dominants in queſtion, as belonging to the mode of *ut*, becauſe it preſerves in the ear the impreſſion of that mode. 2. In a ſeries of dominants, there are a great many of them which likewiſe belong to other modes; for inſtance, the ſimple dominant *la* belongs naturally to the mode of *ſol*, the ſimple dominant *ſi* to that of *la*, &c. Thus it is only improperly, and by way of extenſion, as I have already ſaid, that we regard here theſe dominants as belonging to the mode of *ut*.

(HHHH) Two modes are ſo much more intimately relative as they contain a greater number of ſounds common to both; for example, the minor mode of *ut* and the major of *ſol*, or the major mode of *ut* and the minor

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baſs, by the rules which we have juſt given at the end of the article 242. This ſoliloquy will ſerve for a leſſon to beginners. M. Rameau quotes it in his New Syſtem of Muſic, as an example of modulation highly juſt and extremely ſimple. (See Plate VI. and the following (IIII).

CHAP. XIV. *Of the Chromatic and Enharmonic.*

287 Chromatic, what.

245. WE call that melody *chromatic* which is compoſed of ſeveral notes in ſucceſſion, whether riſing or deſcending by ſemitones. (See LXXXVIII. and LXXXIX.)

288 To an air deſcending by chromatic intervals, fundamental baſs, what.

246. When an air is chromatic in deſcending, the moſt natural and ordinary fundamental baſs is a concatenated ſeries of tonic dominants; all of which follow one another in deſcending by a fifth, or which is the ſame thing, in riſing by a fourth. See LXXXVIII (LLLL).

289 Aſcending, what.

247. When the air is chromatic in aſcending, one may form a fundamental baſs by a ſeries of tonics and of tonic dominants, which ſucceed one another alternately by the interval of a third in deſcending, and of a fourth in aſcending, (ſee LXXXIX). There are many other ways of forming a chromatic air, whether in riſing or deſcending; but theſe details in an elementary eſſay are by no means neceſſary.

290 Enharmonic little practiſed.

248. With reſpect to the enharmonic, it is very rarely put in practice; and we have explained its formation in the firſt book, to which we refer our readers. We ſhall content ourſelves with ſaying, that, in the beautiful ſoliloquy of the fourth act of Dardanus, at the words *lieux funeſtes*, &c. "fatal places, &c." we find an example of the enharmonic; an example of the diatonic enharmonic in the trio of the Fatal Siſters, in Hippolitus and Aricia, at the words, *Ou cours-tu malheureux*, "Whither, unhappy, doſt thou run;" and that there are no examples of the chromatic enharmonic, at leaſt in our French operas. M. Rameau had imitated an earthquake by this ſpecies of muſic, in the ſecond act of the Gallant Indians; but he informs us, that in 1735 he could not cauſe it to be executed by the band. The trio of the Fatal Siſters in Hippolitus has never been ſung in the opera as it is compoſed. But M. Rameau aſſerts, (and we have heard it elſewhere by people of taſte, before whom the piece was performed), that the trial had ſucceeded when made by able hands that were not mercenary, and that its effect was aſtoniſhing.

Principles of Compoſition.

CHAP. XV. *Of Deſign, Imitation, and Fugue.*

See *Deſign*.

291 Deſign, what.

249. IN muſic, the name of *deſign*, or *ſubject*, is generally given to a particular air or melody, which the compoſer intends ſhould prevail through the piece; whether it is intended to expreſs the meaning of words to which it may be ſet, or merely inſpired by the impulſe of taſte and fancy. In this laſt caſe, deſign is diſtinguiſhed into *imitation* and *fugue*.

See *Imitation*.

250. *Imitation* conſiſts in cauſing to be repeated the melody of one or of ſeveral bars in one ſingle part, or in the whole harmony, and in any of the various modes that

292 Imitation, what.

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of *la*: on the contrary, two modes are leſs intimately relative as the number of ſounds which they contain as common to both is ſmaller; for inſtance, the major mode of *ut* and the minor of *ſi*, &c.

When you find yourſelf led away by the current of the modulation, that is to ſay, by the manner in which the fundamental baſs is conſtituted, into a mode remote from that in which the piece was begun, you muſt continue in it but for a ſhort time, becauſe the ear is always impatient to return to the former mode.

(IIII) It is extremely proper to remark, that we have given the fundamental, the continued baſs, and in general the modulation of this ſoliloquy, merely as a leſſon in compoſition extremely ſuitable to *beginners*; not that we recommend the ſoliloquy in itſelf as a model of expreſſion. Upon this laſt object what we have ſaid may be ſeen in what we have written concerning the liberties to be taken in muſic, Vol. IV. p. 435, of our Literary Miſcellany. It is preciſely becauſe this ſoliloquy is a proper leſſon for initiates, that it would be a bad one for the mature and ingenious artiſt. The novice ſhould learn tenaciouſly to obſerve his rules; the man of art and genius ought to know on what occaſions and in what manner they may be violated when this expedient becomes neceſſary.

(LLLL) We may likewiſe give to a chromatic melody in deſcending, a fundamental baſs, into which may enter chords of the ſeventh and of the diminiſhed ſeventh, which may ſucceed one another by the intervals of a falſe fifth and a fifth redundant: thus in the Example XC. where the continued baſs deſcends chromatically, it may eaſily be ſeen that the fundamental baſs carries ſucceſſively the chords of the ſeventh and of the ſeventh diminiſhed, and that in this baſs there is a falſe fifth from *re* to *ſol*♯, and a fifth redundant from *ſol*♯ to *ut*.

The reaſon of this licence is, as it appears to me, becauſe the chord of the diminiſhed ſeventh may be conſidered as repreſenting (art. 221.) the chord of the tonic dominant; in ſuch a manner that this fundamental baſs

7 ♯ 7 7 7 ♯
la re ſol♯ *ut fa*♯ *ſi mi la*

(ſee Example XCI.) may be conſidered as repreſenting (art. 116.) that which is written below,

7 7 7 7 7 ♯
la re mi ut fa♯ *ſi mi la*

Now this laſt fundamental baſs is formed according to the common rules, unleſs that there is a broken cadence from *re* to *mi*, and an interrupted cadence from *mi* to *ut*, which are licenſes (art. 213 and 214.)

Principles of Compoſition.

* See *Air*, *Canon*, *Fugue*.

293 Principal rules for compoſing in ſeveral parts.

that may be choſen. When all the parts abſolutely repeat the ſame air† or melody, and beginning one after the other, this is called a *canon*. *Fugue* conſiſts in alternately repeating that air in the treble, and in the baſs, or even in all the parts, if there are more than two.

251. Imitation and fugue are ſometimes conducted by rules merely deducible from taſte, which may be ſeen in the 332d and following pages of M. Rameau's *Treatiſe on Harmony*; where will likewiſe be found a detail of the rules for compoſition in ſeveral parts. The chief rules for compoſition in ſeveral parts are, that the diſcords ſhould be found, as much as poſſible, prepared and reſolved in the ſame part; that a diſcord ſhould not be heard at the ſame time in ſeveral parts, becauſe its harſhneſs would diſguſt the ear; and that in no particular part there ſhould be found two octaves or two fifths in ſucceſſion (MMMM) with reſpect to the baſs. Muſicians, however, do not heſitate ſometimes to violate this precept, when taſte or occaſion require. In muſic, as in all the other fine arts, it is the buſineſs of the artiſt to aſſign and to obſerve rules; the province of men who are adorned with taſte and genius is to find the exceptions.

CHAP. XVI. *Definitions of the Different Airs.*

252. WE ſhall finiſh this treatiſe by giving in a few words the characteriſtic diſtinctions of the different airs to which names have been given, as *chacoon*, *minuet*, *rigadoon*, &c.

The *chacoon* is a long piece of muſic, containing three times in each bar, of which the movement is regular, and the bars ſenſibly diſtinguiſhed. It conſiſts of ſeveral couplets, which are varied as much as poſſible. Formerly the baſs of the chacoon was a *conſtrained baſs*, or regulated by a rhythmus terminating in 4 bars, and proceeding again by the ſame number; at preſent compoſers of this ſpecies no longer confine themſelves to that practice. The chacoon begins, for the moſt part, not with the perfect time, which is ſtruck by the hand or foot, but with the imperfect, which paſſes while the hand or foot is elevated.

The *villanelle* is a chacoon a little more lively, with its movement ſomewhat more briſk than the ordinary chacoon.

The *paſſacaille* only differs from a chacoon as it is more ſlow, more tender, and beginning for ordinary with a perfect time.

The *minuet* is an air in triple time, whoſe movement is regular, and neither extremely briſk nor ſlow, conſiſting of two parts or ſtrains, which are each of them repeated; and for which reaſon they are called by the French *repriſes*: each ſtrain of the minuet begins with a time which is ſtruck, and ought to conſiſt of 4, of 8, or of 12 bars; ſo that the cadences may be eaſily diſtinguiſhed, and recur at the end of each 4 bars.

The *ſarabando* is properly a ſlow minuet; and the *courant* a very ſlow ſarabando: this laſt is no longer in uſe. The *paſſepied* is properly a very briſk minuet, which does not begin like the common minuet, with a ſtroke of the foot or hand; but in which each ſtrain begins in the laſt of the three times of which the bar conſiſts.

The *loure* is an air whoſe movement is ſlow, whoſe time is marked with $\frac{6}{4}$, and where two of the times in which the bar conſiſts are beaten; it generally begins with that in which the foot is raiſed. For ordinary the note in the middle of each time is ſhortened, and the firſt note of the ſame time pointed.

The *jig* is properly nothing elſe but a loure very briſk, and whoſe movement is extremely quick.

The *forlana* is a moderate movement, and in a mediocrity between the loure and the jig.

The *rigadoon* has two times in a bar, is compoſed of two ſtrains, each to be repeated, and each conſiſting of 4, of 8, or of 12 bars: its movement is lively; each ſtrain begins, not with a ſtroke of the foot, but at the laſt note of the ſecond time.

The *bourée* is almoſt the ſame thing with the rigadoon.

The *gavotte* has two times in each bar, is compoſed of two ſtrains, each to be repeated, and each conſiſting of 4, of 8, or of 12 bars: the movement is ſometimes ſlow, ſometimes briſk; but never extremely quick, nor very ſlow.

The *tambourin* has two ſtrains, each to be repeated, and each conſiſting of 4, of 8, or of 12 bars, &c. Two of the times that make up each bar are beaten, and are very lively; and each ſtrain generally begins in the ſecond time.

The *muſette* conſiſts of two or three times in each bar; its movement is neither very quick nor very ſlow; and for its baſs it has often no more than a ſingle note, which may be continued through the whole piece.

APPENDIX.

THE treatiſe of D'Alembert, of which we have given a tranſlation, is well entitled to the merit of accuracy; but perhaps a perſon who has not particularly ſtudied the ſubject, may find difficulty in following the ſcientific deductions of that author.—We ſubjoin, therefore, a few general obſervations on the philoſophy of muſical ſound, commonly called *harmonics*, which may perhaps convey the full portion of knowledge of the theory of muſic, with which one in ſearch only of general information, and not a profeſſed ſtudent of this particular ſcience, would chooſe to reſt ſatisfied.

The theory of muſical ſound, which only in the beginning of the preſent century was ultimately eſtabliſhed by mathematical demonſtration, is no other than that which diſtinguiſhed the ancient muſical ſect who

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(MMMM) Yet there may be two fifths in ſucceſſion, provided the parts move in contrary directions, or, in other words, if the progreſs of one part be aſcending, and the other deſcending; but in this caſe they are not properly two fifths, they are a fifth and a twelfth; for example, if one of the parts in deſcending ſhould found *ſa re*, and the other *ut la* in riſing, *ut* is the fifth of *ſa*, and *la* the twelfth of *re*.

General observations on Harmonics.

who followed the opinions of Pythagoras on that ſubject.

No part of natural philoſophy has been more fruitful of hypotheſis than that of which muſical ſound is the object. The muſical ſpeculators of Greece arranged themſelves into a great number of different ſects, the chief of whom were the Pythagoreans and the Ariſtoxenians.

Pythagoras ſuppoſed the air to be the *vehicle* of ſound; and the agitation of that element, occaſioned by a ſimilar agitation in the parts of the ſounding body, to be the *cauſe* of it. The vibrations of a ſtring or other ſonorous body, being communicated to the air, affected the auditory nerves with the ſenſation of ſound; and this ſound, he argued, was acute or grave in proportion as the vibrations were quick or ſlow.—He diſcovered by experiment, that of two ſtrings èqual in every thing but length, the ſhorter made the quicker vibrations, and emitted the acuter ſound:—in other words, that the number of vibrations made in the ſame time, by two ſtrings of different lengths, was inverſely as thoſe lengths; that is, the greater the length the ſmaller the number of vibrations in any given time. Thus ſound, conſidered in the vibrations that cauſe it, and the dimenſions of the vibrating body, came to be reduced to quantity, and as ſuch was the ſubject of calculation, and expreſſible by numbers.—For inſtance, the two ſounds that form an octave could be expreſſed by the numbers 1 and 2, which would repreſent either the number of vibrations in a given time, or the length of the ſtrings; and would mean, that the acuter ſound vibrates twice, while the graver vibrates once; or that the ſtring producing the lower ſound is twice the length of that which gives the higher. If the vibrations were conſidered, the higher ſound was as 2, the lower as 1; the reverſe, if the length was alluded to. In the ſame manner, in the ſame ſenſe, the 5th would be expreſſed by the ratio of 2 to 3, and the 4th by that of 3 to 4.

Ariſtoxenus, in oppoſition to the calculations of Pythagoras, held the ear to be the ſole ſtandard of muſical proportions. That ſenſe he accounted ſufficiently accurate for muſical, though not for mathematical, purpoſes; and it was in his opinion abſurd to aim at an artificial accuracy in gratifying the ear beyond its own power of diſtinction. He, therefore, rejected the velocities, vibrations, and proportions of Pythagoras as foreign to the ſubject, in ſo far as they ſubſtituted *abſtract cauſes* in the room of *experience*, and made muſic the object of *intellect* rather than of *ſenſe*.

Of late, however, as has been already mentioned, the opinions of Pythagoras have been confirmed by abſolute demonſtration; and the following propoſitions, in relation to muſical ſound, have paſſed from conjecture to certainty. General obſervations on Harmonics.

Sound is generated by the vibrations of elaſtic bodies, which communicate the like vibrations to the air, and theſe again the like to our organs of hearing. This is evident, becauſe ſounding bodies communicate tremors to other bodies at a diſtance from them. The vibrating motion, for inſtance, of a muſical ſtring, excites motion in others, whoſe tenſion and quantity of matter diſpoſe their vibrations to keep time with the undulations of air propagated from it (the ſtring firſt ſet in motion.)

If the vibrations be iſochronous, and the ſound muſical, continuing at the ſame pitch, it is ſaid to be acuter, ſharper, or higher, than any other ſound whoſe vibrations are ſlower; and graver, flatter, or lower, than any other whoſe vibrations are quicker.—For while a muſical ſtring vibrates, its vibrations become quicker by increaſing its tenſion or diminiſhing its length; its ſound at the ſame time will be more acute: and, on the contrary, by diminiſhing its tenſion or increaſing its length, the vibrations will become ſlower and the ſound graver. The like alteration of the pitch of the ſound will follow, by applying, by means of a weight, an equal degree of tenſion to a thicker or heavier and to a ſmaller or lighter ſtring, both of the ſame length, as in the ſmaller ſtring the maſs of matter to be moved by the ſame force is leſs.

If ſeveral ſtrings, however, different in length, denſity, and tenſion, vibrate altogether in equal times, their ſounds will have all one and the ſame pitch, however they may differ in loudneſs or other qualities.—They are called *uniſons*. The vibrations of uniſons are iſochronous.

The vibrations of a muſical ſtring, whether wider or narrower, are nearly iſochronous. Otherwiſe, while the vibrations decreaſe in breadth till they ceaſe, the pitch of the ſound could not continue the ſame (which we perceive by experience it does), unleſs where the firſt vibrations are made very violently; in which caſe, the ſound is a little acuter at the beginning than afterwards.

Laſtly, the word *vibration* is underſtood to mean the time which paſſes between the departure of the vibrating body from any aſſigned place and its return to the ſame.

MUS MUS

Glaſs-Muſic. See HARMONICA.

MUSIMON, in natural hiſtory, the name of an animal eſteemed a ſpecies of ſheep, deſcribed by the ancients as common in Corſica, Sardinia, Barbary, and the north-eaſt parts of Aſia. It has been doubted whether the animal deſcribed under this name is now any where to be found in the world; and whether it was not, probably, a ſpurious breed between two animals of different ſpecies, perhaps the ſheep and goat, which, like the mule, not being able to propagate its ſpecies, the production of them may have been diſcontinued.

Buffon ſuppoſes it to be the ſheep in a wild ſtate; and it is deſcribed as ſuch by Mr Pennant. Theſe animals live in the mountains, and run with great ſwiftneſs among the rocks. Thoſe of Kamtſchatka are ſo ſtrong, that 10 men can ſcarce hold one; and the horns are ſo large as ſometimes to weigh 30 pounds,

and

Tone tone semitone tone tone tone semitone

A ut re mi fa sol la si VT

B ut re mi fa sol la si VT RE MI FA SOL &

Scale first. Scale Second.

The diatonic Scale of the Greeks.

D
Si Ut Re Mi Fa Sol La
Sol Ut Sol Ut Fa Ut Fa
The Fundamental bass.

E
Ut RE Mi Fa Sol Sol La Si Ut
Ut Sol Ut Fa Ut Sol Re Sol Ut
The Fundamental bass

F VT, VT ✱, re, re ✱, mi, mi ✱, fa ✱, SOL, sol ✱, LA, la ✱, si si ✱, ut, ut ✱, RE, RE ✱, MI, MI ✱,

Scale first. Scale Second.

The first Scale of the minor mode.

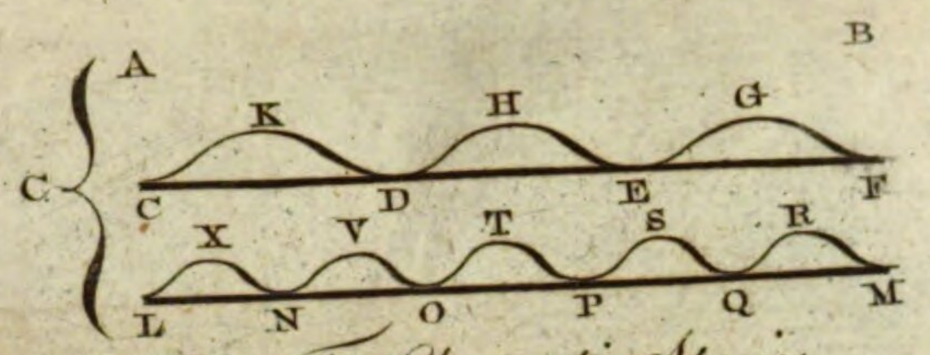
G
Sol La Si Ut Re Mi Fa
(Third minor) (Third minor) (Third minor)
Mi La Mi La Re La Re
The fundamental bass.

The second scale of the minor mode.

H
La Si Ut Re Mi mi fa✱ Sol✱ La
La Mi La Re La Mi Si Mi La
The Fundamental bass.

Scale.

I
Ut Re Mi Fa Sol La Si Ut
Ut Sol Ut Fa Ut Re Sol Ut



The Chromatic Species.

Scale.

K
Sol Sol &c.
Ut Mi Sol✱
The Fundamental bass.

Scale

L
Ut Mi Si✱
Ut Mi Sol✱
The Fundamental bass.

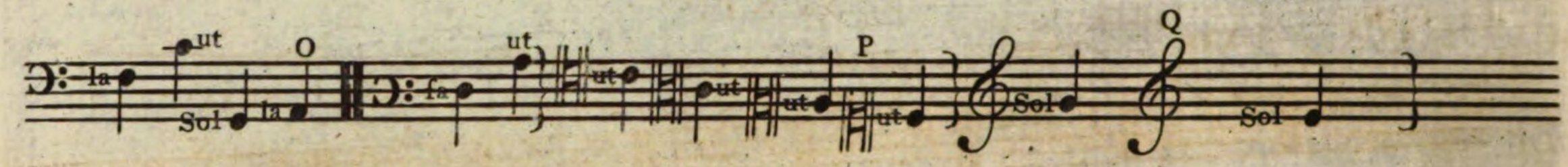
Scale

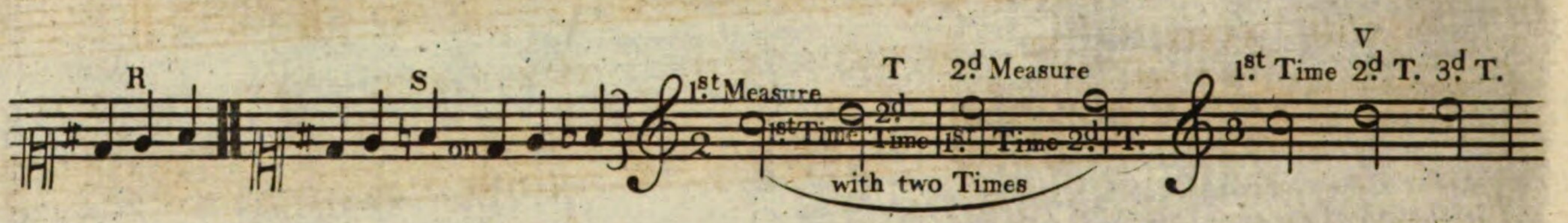
N
Mi♭ Mi Mi Mi Mi✱
Ut Ut La Ut Ut
The Fundamental bass.

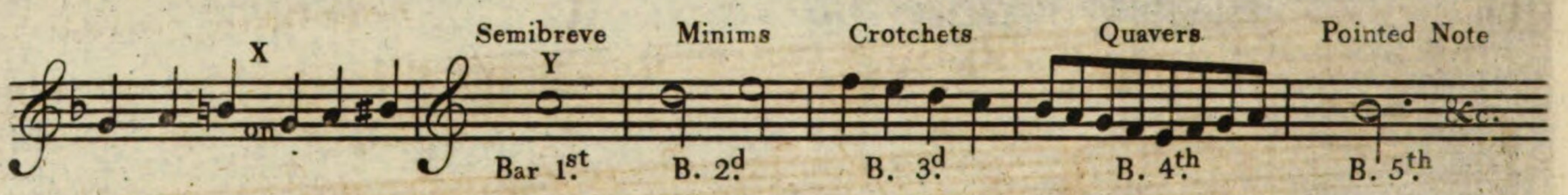
Scale.

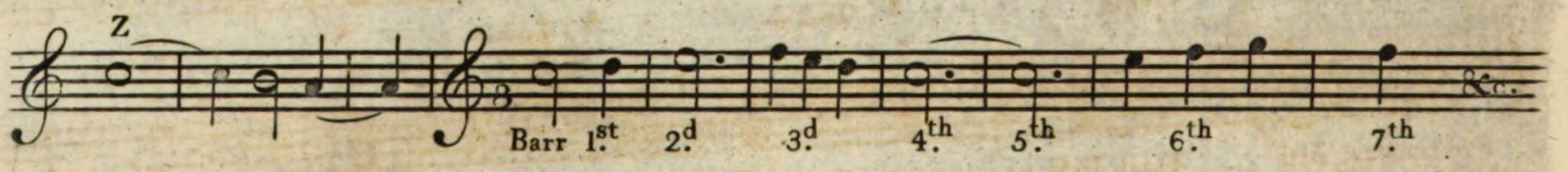
M
Fa Mi Mi Re
Fa Ut Mi Si
The Fundamental bass.

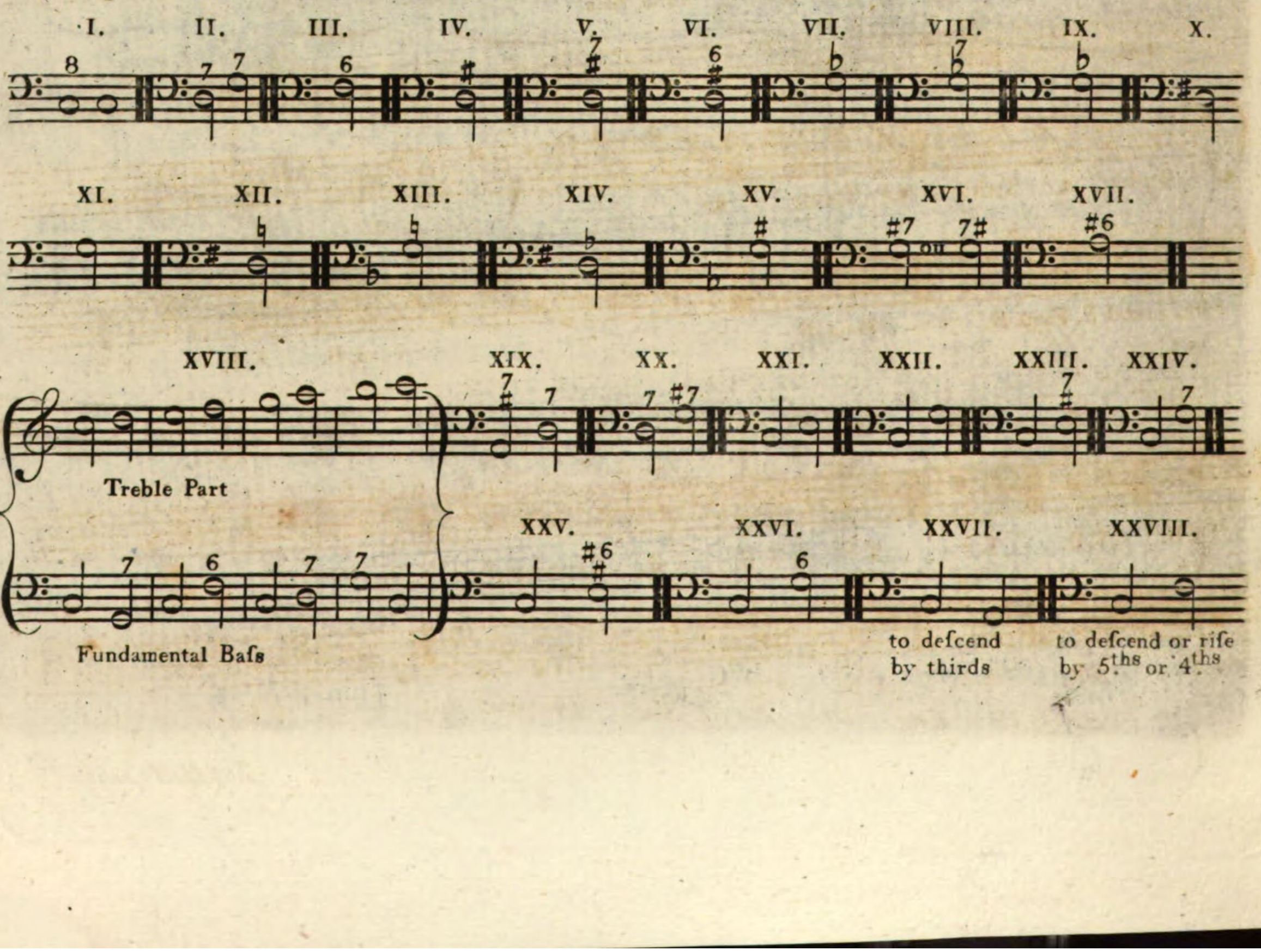
A Bell Sculp.

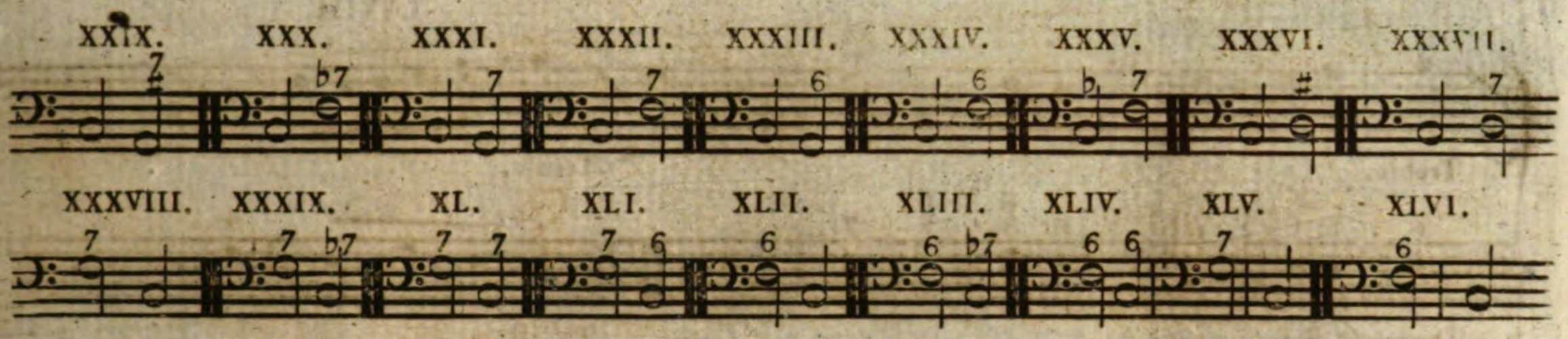

O
P
Q
ut
Sol
la
fa

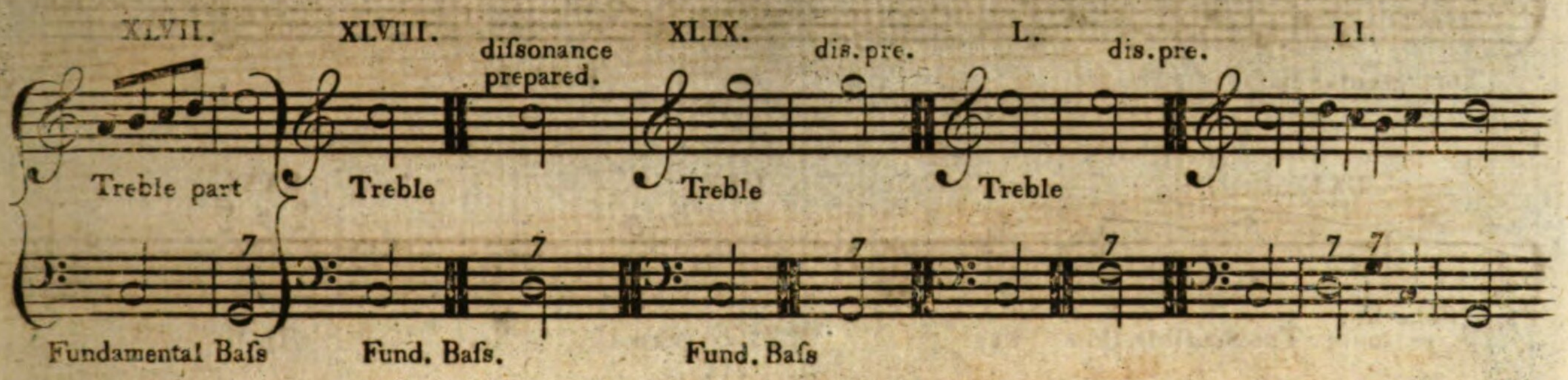

R
S
T
V
1st Measure
2d Measure
1st Time
2d Time
with two Times
1st Time 2d Time 3d Time

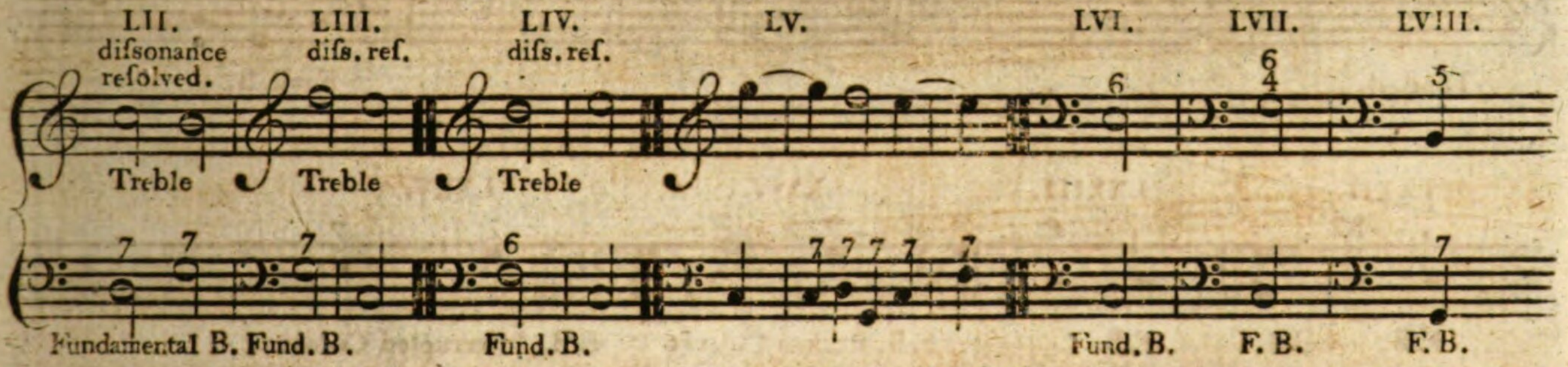

X
Y
Semibreve
Minims
Crotchets
Quavers
Pointed Note
Bar 1st
B. 2d
B. 3d
B. 4th
B. 5th
&c.

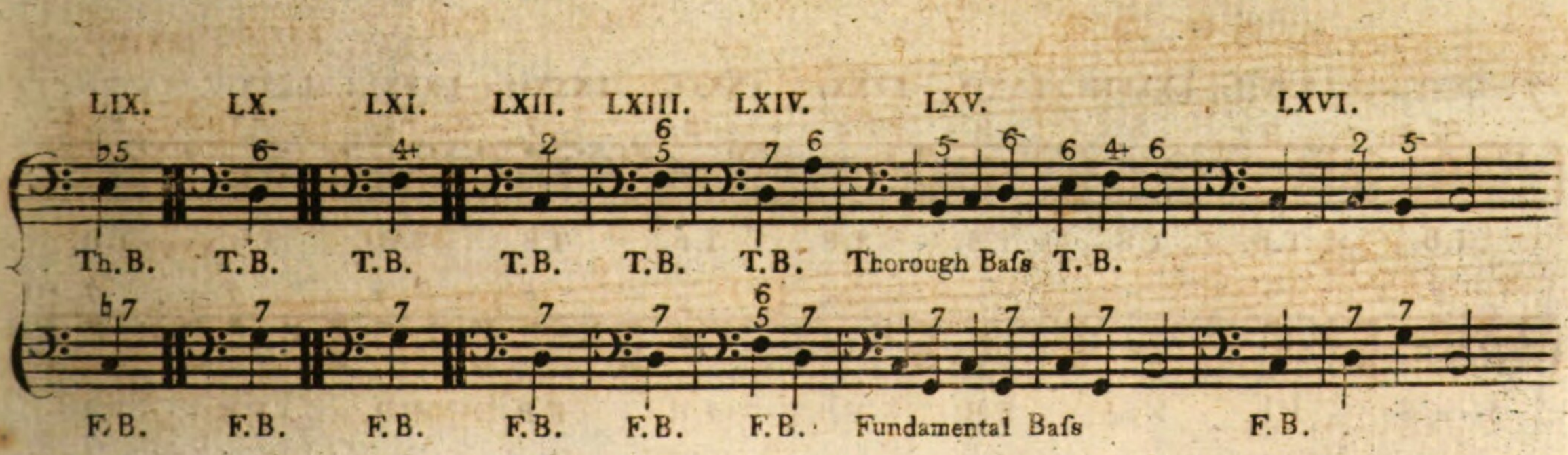

Z
Barr 1st
2d
3d
4th
5th
6th
7th
&c.


I. II. III. IV. V. VI. VII. VIII. IX. X.
XI. XII. XIII. XIV. XV. XVI. XVII.
XVIII. XIX. XX. XXI. XXII. XXIII. XXIV.
Treble Part
XXV. XXVI. XXVII. XXVIII.
Fundamental Bafs
to defcend by thirds
to defcend or rife by 5ths or 4ths

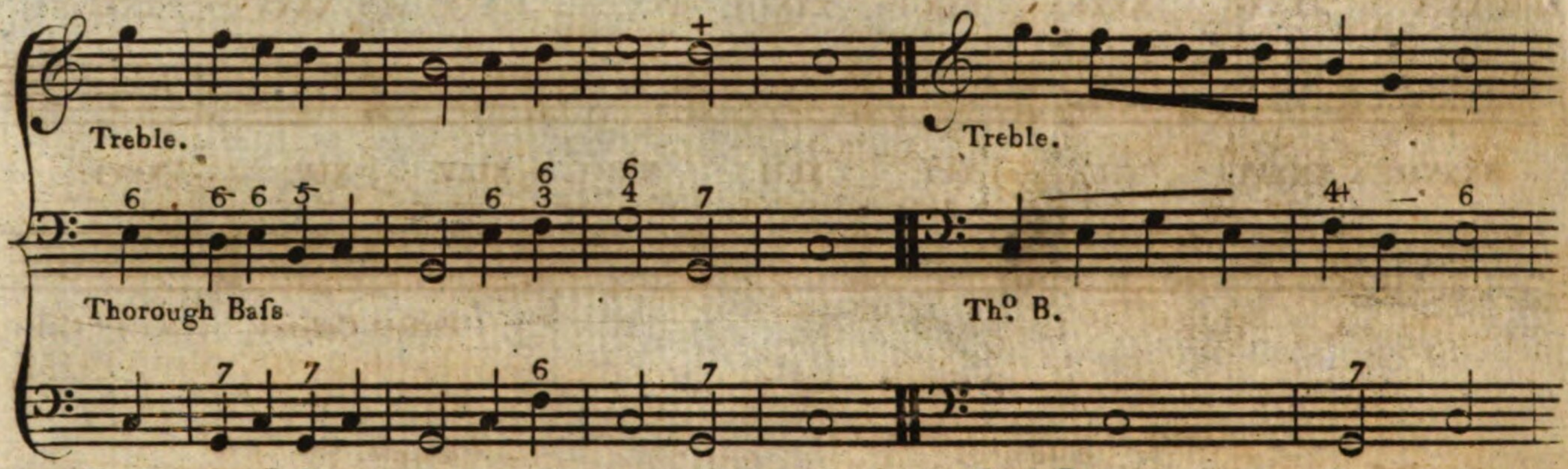

XXIX.
XXX.
XXXI.
XXXII.
XXXIII.
XXXIV.
XXXV.
XXXVI.
XXXVII.
XXXVIII.
XXXIX.
XL.
XLI.
XLII.
XLIII.
XLIV.
XLV.
XLVI.
Perfect Cadence
unperfect Cad:


XLVII.
XLVIII.
difsonance prepared.
XLIX.
dis. pre.
L.
dis. pre.
LI.
Treble part
Treble
Treble
Treble
Fundamental Bafs
Fund. Bafs.
Fund. Bafs


LII.
difsonance resolved.
LIII.
difs. ref.
LIV.
difs. ref.
LV.
LVI.
LVII.
LVIII.
Treble
Treble
Treble
Fundamental B.
Fund. B.
Fund. B.
Fund. B.
F. B.
F. B.

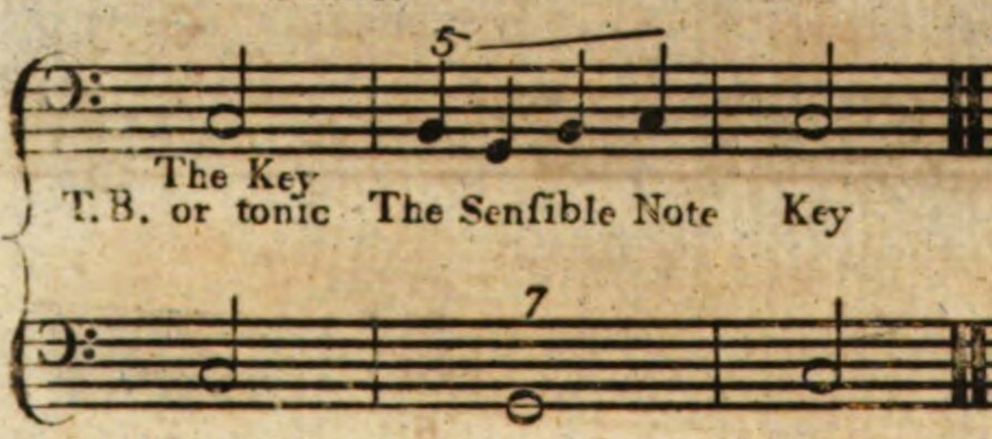

LIX.
LX.
LXI.
LXII.
LXIII.
LXIV.
LXV.
LXVI.
Th. B.
T. B.
T. B.
T. B.
T. B.
T. B.
Thorough Bafs
T. B.
F. B.
F. B.
F. B.
F. B.
F. B.
F. B.
Fundamental Bafs
F. B.

LXVII.



LXVIII.

LXIX.



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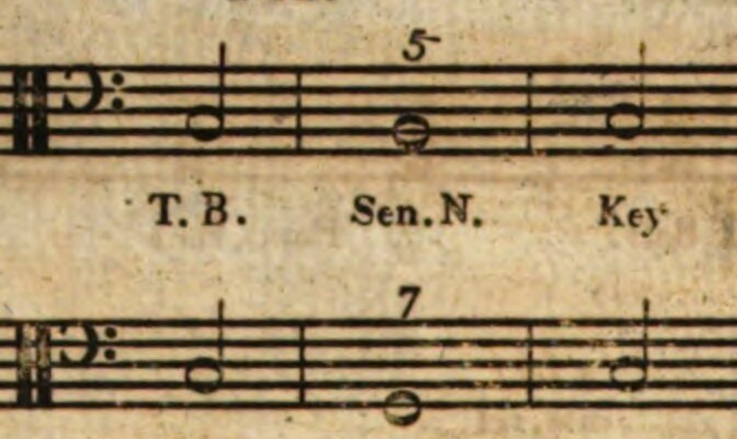

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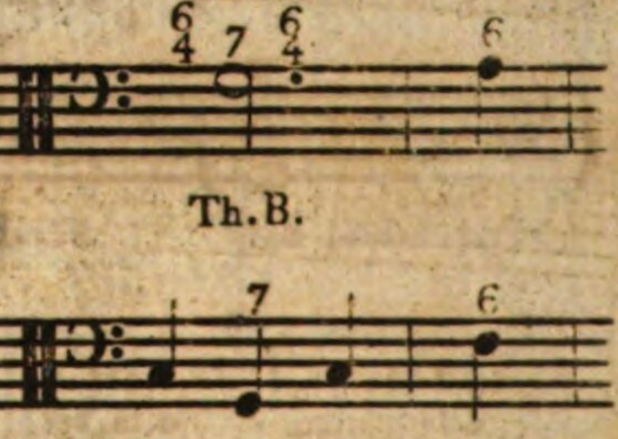

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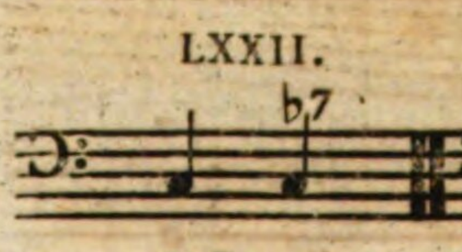

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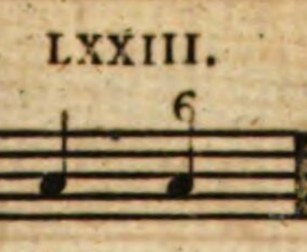

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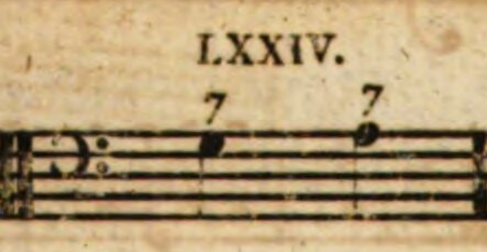

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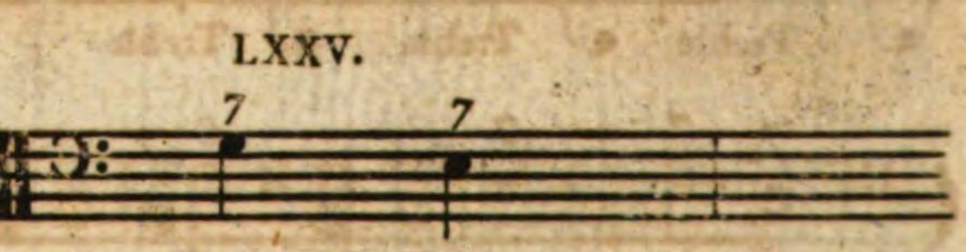


LXXVI. LXXVII. LXXVIII. LXXIX. LXXX. LXXXI. LXXXII. LXXXIII. LXXXIV. LXXXV.

LXXXVI. LXXXVII. LXXXVIII. LXXXIX.

Cromatic modulation defcending. Cromatic modulation afcending.

T.B. T.B. The Treble The Treble

F.B. F.B. Fund.B. Fund.B.

XC. XCI.

Treble Fund. B.

T.B. Fund. B.

F. B. XCII.

Treble.

Fund B.

XCIII. XCIV. XCV.

Treble Th. B. F. B.

Fund. B. F. B.

En ſin, il eſt en ma puiſ_ſance, Ce fatal enne mi, Ce ſuperbe vain_

Th.B.

F.B.

_queur, Le charme du ſom meil le livre à ma ven_geance, Je vais per_

T.B.

F.B.

cer ſon in vin ci ble cœur; Par luy, tous mes Captifs ſont ſortis d eſcla

T.B.

F.B.

vage; Qu'il eprouve toute ma rage Quel trouble me ſaiſit! Qui me ſait héſi_

Th.B.

F.B.

ter. Queſtce qu'én ſa fa _veur la pilié me veut di re. Frapons, Ciel! qui peut márrê

Th.B.

F.B.

ter. Achevons je fremis! Vengeons nous je ſoû pire! Eſt_ce ainſi que je

Th.B.

F.B.

MUSIC.

dois me venger anjour d'huy! Ma co_le_re ſé teint Quand j aproche de luy

Th.B.

F. B.

Plus je le vois! plus ma vengeance eſt vaine; Mon bras tremblant ſe re_

Th.B.

F. B.

ſuſe á ma haine: Ah! quelle cruau te de luy ravir le jour! A ce jeune He_

Th.B.

F. B.

ros, tout cé_de ſur la terre: Qui croiroit qu'il fût ne ſeulement pour la guerre, Il

Th.B.

F.B.

ſemble être fait pour l'A mour. Ne puis_je me venger á moins qu'il ne pe

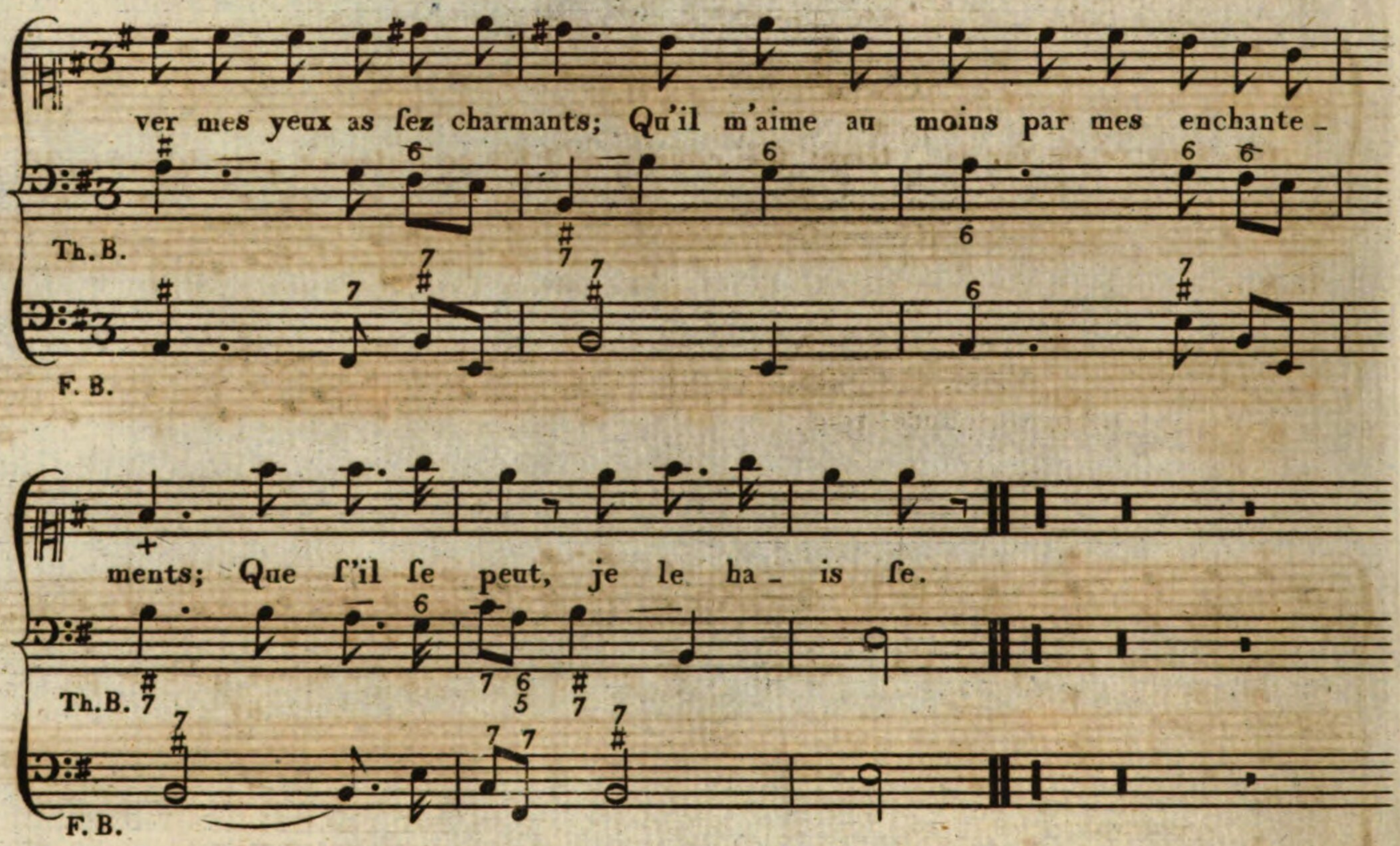
Th.B.

F.B.

riſſe. Hé! ne ſuffi_t_il pas que l'Amour le pu niſſe. Puiſqu'il n'a pu trou

Th.B.

F.B.



Tranſlation. Intended to give ſuch Readers as do not underſtand French, an idea of the Song.

At length the victim in my power I ſee,
This fatal year reſigns him to my rage;
Subdued by ſleep he lies, and leaves me free,
With chaſtening hand my fury to aſswage.
That mighty heart invincible and fierce.
Which all my captives free'd from ſervile chains;
That mighty heart, my vengeful hand ſhall pierce;
My rage inventive wanton in his pains.
Ha! in my ſoul what perturbation reigns!
What would compaſsion in his favour plead.
Strike, hand. O heaven! what charm thy force reſtrains.
Obey my wrath. I ſigh; yet let it bleed.
And is it thus my juſt revenge improves
The fair occaſion to chaſtize my foe
As I approach, a ſofter paſsion moves,
And all my boaſting fury melts in wo.
Trembling, relax'd, and faithleſs to my hate,
The dreadful taſk this coward arm declines.

How cruel thus to urge his inſtant fate,
Depriv'd of life amid his great deſigns!
In youth how blooming! what a heavenly grace,
Thro' all his form, reſiſtleſs power diſplays!
How ſweet the ſmile that dwells upon his face,
Relentleſs rage diſarming whilſt I gaze!
Tho' to the proweſs of his conquering arms
Earth ſtood with all her hoſts oppos'd in vain;
Yet is he form'd to ſpread more mild alarms,
And bind all nature in a ſofter chain.
Can then his blood, his precious blood, alone
Extinguiſh all the vengeance in my heart.
Tho' ſtill ſurviving, might he not atone.
For all the wrongs I feel, by gentler ſmart.
Since all my charms, unfeeling, he defies,
Let Magic force his ſtubborn ſoul ſubdue;
Whilſt I, inflexible to tears and ſighs,
With hate (if I can hate) his peace purſue.

Musis || Musk.

and so capacious, that young foxes often shelter themselves in the hollow of such as by accident fall off in the deserts. See Ovis.

MUSIS (Agostino de), a noted engraver, better known by the name of *Agostino Veneziano*, or in England by that of "Augustin the Venetian;" but *Musis* was his proper family name. He was a native of Venice, and scholar of Marc Antonio Raimondi. It is not certain at what period he begun his studies under that celebrated master; but the first dated print by Agostino appeared A. D. 1509, at which time, it is probable, his tutor still resided at Venice. After the death of Raphael, which happened in 1520, Agostino de Musis, and Marc de Ravenna, his fellow-disciple, who had conjointly assisted each other, separated, and worked entirely upon their own account. It is uncertain at what time Agostino died; but his prints are not dated later than 1536. So that it may be reasonably supposed that he did not long survive that period. Agostino de Musis imitated the style of his master with great attention, and was, upon the whole, the most successful of all his scholars. In neatness and mechanical execution with the graver, he has often equalled if not sometimes exceeded him; but in point of taste, and in the purity and correctness of outline, he certainly fell greatly short of him. Agostino's drawing had more of manner and stiffness; the heads of his figures are not so accurately marked; nor the other extremities expressed with equal truth.

MUSIVUM AURUM. See CHEMISTRY, n° 1224.

MUSK, a very strong-scented substance found under the belly of an East Indian animal. See MOSCHUS.

According to Tavernier, the best and greatest quantities of musk come from the kingdom of Boutan, from whence it is carried for sale to Patna, the chief town of Bengal. After killing the animal, the peasants cut off the bag, which is about the size of an egg, and is situated nearer the organs of generation than the navel. They next take out the musk, which has then the appearance of clotted blood. When they want to adulterate it, they put a mash of the animal's blood and liver into the place of the musk they had extracted. In two or three years this mixture produces certain small animals which eat the good musk; so that, when opened, a great consumption is perceived. Others, after extracting a portion of the musk, put in small pieces of lead to augment the weight. The merchants who transport the musk to foreign countries are less averse to this trick than the former; because in this case none of the animals abovementioned are produced. But the deceit is still worse to discover, when, of the skin taken from the belly of a young animal, they make little bags, which they sew so dexterously with threads of the same skin, that they resemble genuine bags. Those they fill with what they take out of the genuine bags, and some fraudulent mixture, which it is extremely difficult for the merchants to detect. When the bags are sewed immediately on their being cut, without allowing any part of the odour to dissipate in the air, after they have abstracted as much of the musk as they think proper, if a person applies one of these bags to his nose, blood will be drawn by the mere force of the odour, which must necessarily be weakened or diluted in order to render it agreeable without injuring the brain. Our author brought one of the animals with him to Paris, the odour of which was so strong, that it was impossible for him to keep it in his chamber. It made every head in the house giddy; and he was obliged to put it in a barn, where the servants at last cut away the bag: the skin, notwithstanding, always retained a portion of the odour. The largest musk-bag seldom exceeds the size of a hen's egg, and cannot furnish above half an ounce of musk: three or four of them are sometimes necessary to afford a single ounce. In one of his voyages to Patna, Tavernier purchased 1663 bags, which weighed 1557 ounces and a half; and the musk, when taken out of the bags, weighed 452 ounces. Musk.

Musk affords the strongest of all known odours. A small bit of it perfumes a large quantity of matter. The odour of a small particle extends through a considerable space. It is likewise so fixed and permanent, that at the end of several years it seems to have lost no part of its activity. When it comes to us, it is dry, with a kind of unctuosity, of a dark reddish-brown or rusty blackish colour, in small round grains, with very few hard black clots, and perfectly free from any sandy or other visible foreign matter. If chewed, and rubbed with a knife on paper, it looks smooth, bright, yellowish, and free from bitterness. Laid on a red hot iron, it catches flame, and burns almost entirely away, leaving only an exceeding small quantity of light greyish ashes: if any earthy substances have been mixed with the musk, the quantity of the residuum will readily discover them.

Musk has a bitterish subacrid taste; a fragrant smell, agreeable at a distance, but when smelt near to, so strong as to be disagreeable unless weakened by the admixture of other substances. If a small quantity be infused in spirit of wine in the cold for a few days, it imparts a deep, but not red tincture: this, though it discovers no great smell of the musk, is nevertheless strongly impregnated with its virtues; a single drop of it communicates to a whole quart of wine a rich musky flavour. The degree of flavour which a tincture drawn from a known quantity of musk communicates to vinous liquors, is perhaps one of the best criteria for judging of the goodness of this commodity. Neumann informs us, that spirit of wine dissolves 10 parts out of 30 of musk, and that water takes up 12; that water elevates its smell in distillation, whilst pure spirit brings over nothing.

Musk is a medicine of great esteem in the eastern countries; among us, it has been for some time pretty much out of use, even as a perfume, on a supposition of its occasioning vapours, &c. in weak females and persons of a sedentary life. It appears, however, from late experience, to be, when properly managed, a remedy of good service even against those disorders which it has been supposed to produce. Dr Wall has communicated (in the Philosoph. Transac. n° 474.) an account of some extraordinary effects of musk in convulsive and other diseases, which have too often baffled the force of medicine. The doctor observes, that the smell of perfumes is often of disservice, where the substance, taken inwardly and in considerable quantity produces the happiest effects; that two persons, labouring under a *subsultus tendinum*, extreme anxiety, and want of sleep, from the bite of a mad dog,

Muſk || Muſſulman

dog, by taking two doſes of muſk, each of which was 16 grains, were perfectly relieved from their complaints. He likewiſe obſerves, that convulſive hiccups, attended with the worſt ſymptoms, were removed by a doſe or two of 10 grains; and that in ſome caſes, where this medicine could not, on account of ſtrong convulſions, be adminiſtered to the patient by the mouth, it proved of ſervice when injected as a glyſter. He likewiſe adds, that under the quantity of ſix grains, he never found much effect from it; but that, taken to 10 grains and upwards, it never fails to produce a mild diaphoreſis, without at all heating or giving any uneaſineſs: that, on the contrary, it eaſes pain, raiſes the ſpirits; and that, after the ſweat breaks out, the patient uſually falls into a refreſhing ſleep: that he never met with any hyſterical perſon, how averſe ſoever to perfumes, but could take it, in the form of a bolus, without inconvenience. To this paper is annexed an account of ſome farther extraordinary effects of muſk, obſerved by another gentleman. Repeated experience has ſince confirmed its efficacy in theſe diſorders. The doſe has ſometimes been increaſed, particularly in convulſive diſorders, to the quantity of a ſcruple or half a dram every three or four hours, with two or three ſpoonfuls of the muſk julep between. The julep is the only officinal preparation of it. It is combined with opium in tetanus, and with mercury in rabies canina.

Muſk-Animal. See Moschus.

Muſk-Ox. See Bos.

Muſk-Rat, in zoology. See Castor.

MUSKET, or Musquet, properly a fire-arm borne on the ſhoulder, and uſed in war; to be fired by the application of a lighted match.

The length of the barrel is fixed to three feet eight inches from the muzzle to the touch-pan, and its bore is to be ſuch as may receive a bullet of 14 in a pound, and its diameter differs not above one 50th part from that of the bullet.

Muſkets were anciently borne in the field by the infantry, and were uſed in England ſo lately as the beginning of the civil wars. At preſent they are little uſed, except in the defence of places; fuſees or firelocks having taken their place and name.

MUSKETOON, a kind of ſhort thick muſket, whoſe bore is the 38th part of its length: it carries five ounces of iron, or ſeven and an half of lead, with an equal quantity of powder. This is the ſhorteſt kind of blunderbuſſes.

MUSLIN, a fine ſort of cotton cloth, which bears a downy knot on its ſurface. There are ſeveral ſorts of muſlins brought from the Eaſt Indies, and more particularly from Bengal; ſuch as doreas, betelles, mulmuls, tanjecbs, &c. Muſlin is now manufactured in Britain, and brought to very great perfection.

MUSONIUS, (Caius Rufus), a Stoic philoſopher of the ſecond century, was baniſhed into the iſland of Gyare, under the reign of Nero, for criticiſing the manners of that prince; but was recalled by the emperor Veſpaſian. He was the friend of Apollonius Tyanæus, and the letters that paſſed between them are ſtill extant.

MUSQUETOE. See Culex.

MUSSULMAN, or Musylman, a title by which the Mahometans diſtinguiſh themſelves; ſignifying, in the Turkiſh language, "true believer, or orthodox." See Mahometanism. Muſſulman Muſt.

In Arabic, the word is written *Moſlem*, *Moſleman*, or *Moſolman*. The appellation was firſt given to the Saracens, as is obſerved by Leunclavius.—There are two kinds of Muſſulmans, very averſe to each other; the one called *Sonnites*, and the other *Shiites*.—The Sonnites follow the interpretation of the Alcoran given by Omar; the Shiites are the followers of Ali. The ſubjects of the king of Perſia are Shiites; and thoſe of the grand ſignior, Sonnites. See Sonna, and Alcoran.

Some authors will have it, that the word Muſſulman ſignifies *ſaved*, that is, predeſtinated; and that the Mahometans give themſelves the appellation, as believing they are all predeſtinated to ſalvation.—Martininius is more particular as to the origin of the name; which he derives from the Arabic מסלם, *muſalem*, "ſaved, ſnatched out of danger:" the Mahometans, he obſerves, eſtabliſhing their religion by fire and ſword, maſſacred all thoſe who would not embrace it, and granted life to all that did, calling them *Muſſulmans*, q. d. *erepti è periculo*; whence the word, in courſe of time, became the diſtinguiſhing title of all thoſe of that ſect, who have affixed to it the ſignification of *true believers*.

MUST, Mustum, ſweet wine newly preſſed from the grape; or the new liquor preſſed from the fruit before it has worked or fermented. See Wine.

Muſt of Rheniſh wine. This is a liquor that, tho' drank by ſome, is found extremely to affect the brain; for not having paſſed the natural efferveſcence which it would have been ſubject to, in the making of wine, its ſalts are locked up till the heat of the ſtomach ſetting them to work, they raiſe their efferveſcence there, and ſend up abundance of ſubtile vapours to the brain. The Rheniſh muſt is of two kinds, being made either with or without boiling. That made without boiling is only put up ſo cloſe in the veſſel that it cannot work; this is called *ſtumm-wine*. That by boiling is thus prepared: they take ſtrong veſſels not quite filled, and putting them into a cellar, they make a fire mild at firſt, but increaſed by degrees, and afterwards they gradually leſſen it again, that the boiling may ceaſe of itſelf. This operation is finiſhed in 36 or 40 hours, according to the ſize of the veſſel; and the wine-boilers, inſtead of common candles, which would melt by the heat, uſe thin pieces of ſplit beech-wood. Theſe alſo ſerve for a double purpoſe, not only lighting them, but giving them notice of the boiling being enough; before that time, the quantity of vapours thrown up make them burn dim; but as ſoon as it is finiſhed, the vapours aſcend in leſs quantity, and the lights burn briſk and clear. About ſeven or eight days after this boiling, the muſt begins to work, and after this working it is called *wine*. They have alſo another kind of Rheniſh muſt which is thus prepared: they boil the liquor to half the quantity, and put into it the medicinal ingredients they are moſt fond of; ſuch as orange-peel, elecampane-root, and juniper-berries, or the like; being thus medicated, the whole works much more ſlowly than it otherwiſe would.—If the boiled muſt by too violent an efferveſcence caſt out its lees, it will on this become vapid and dead, unleſs this ſeparation is ſtopped by ſome fatty ſubſtance,

Muſtard, Muſtella.

ſtance, ſuch as freſh butter or the like: they put this in upon a vine leaf, or elſe apply hard to the mouth of the veſſel.

A muſt for artificial wine may be thus made. Take 20 pounds of fine ſugar, five gallons of water, four ounces of white tartar finely pulverized, or cream of tartar, and boil them in a large veſſel over a gentle fire.

MUSTARD. See SINAPI.

MUSTARD-Seed, is one of the ſtrongeſt of the pungent, ſtimulating, diuretic medicines, that operate without exciting much heat. It is ſometimes taken unbruiſed, to the quantity of a ſpoonful at a time, in paralytic, cachectic, and ſerous diſorders. It is applied alſo as an external ſtimulant, to benumbed and paralytic limbs; to parts affected with fixed rheumatic pains; and to the ſoles of the feet, in the low ſtage of acute diſeaſes, for raiſing the pulſe; in this intention, a mixture of equal parts of the powdered ſeeds and crumbs of bread, with the addition ſometimes of a little bruiſed garlic, are made into a cataplaſm with a ſufficient quantity of vinegar. See SINAPISM.

Muſtard-ſeed yields upon expreſſion, a conſiderable quantity of oil, which is by ſome recommended externally againſt rheumatiſms and palſies, though it has nothing of that quality by which the ſeeds themſelves prove uſeful in thoſe diſorders; the oil being mild and inſipid as that of olives, and the pungency of the ſeed remaining entire in the cake left after expreſſion; nor is any conſiderable part of the pungent matter extracted by rectified ſpirit. The bruiſed ſeeds give out readily to water nearly the whole of their active matter: added to boiling milk they curdle it, and communicate their pungency to the whey. The powder of muſtard-ſeed may be made into the conſiſtence of a loch with warm water, in which a little ſea-ſalt has been diſſolved. Of this a common ſpoonful, ſometimes two, diluted with tepid water, are given on an empty ſtomach; it operates as well as an emetic, and proves an excellent remedy in moſt nervous diſorders, according to Dr Monro, in Med. Eſſ. Edinb. vol. ii. art. 19. p. 303. note.

MUSTELA, the OTTER and WEASEL; a genus of quadrupeds of the order of feræ. There are ſix cutting teeth in each jaw; thoſe of the upper jaw, erect, ſharp-pointed, and diſtinct; of the lower jaw, blunter, huddled together, and two placed within the line of the reſt: The tongue is ſmooth.

Plate CCCXXXIII

1. The lutris, or ſea-otter, having hairy feet and a hairy tail. The length from noſe to tail is about three feet long, and the tail is about 13 inches; the body and the limbs are black, except the fore-part of the head, which is white or grey; the largeſt individual weighs from 70 to 80 pounds; the fur is very thick, long, black, and gloſſy, ſometimes varying to ſilvery, with a ſoft down beneath. The ſea-otter inhabits the coaſts of North-weſt America and Eaſtern Aſia, and the intermediate iſlands. It lives moſtly in the ſea, and ſwims with great facility; frequenting ſhallows which abound in ſea-weeds, and feeding on lobſters, fiſh, *ſepiæ* or cuttle-fiſh, and ſhell-fiſh. It is a harmleſs animal; very affectionate to its young, inſomuch that it will pine to death at the loſs of them, and die on the very ſpot where they have been taken from it. Before the young can ſwim, the dams carry them in their paws, lying in the water on their backs: they ſwim often on their back, their ſides, and even in a perpendicular poſture; are very ſportive; embrace, and kiſs each other: they breed but once a-year, and have but one young at a time, ſuckle it for a year, and bring it on ſhore. They are dull-ſighted, but quick-ſcented; and run very ſwiftly on land. They are hunted for their ſkins, which are of great value; being ſold to the Chineſe for 70 or 80 rubles a-piece: each ſkin weighs $3\frac{1}{2}$ lib. The young are reckoned very delicate meat, ſcarce to be diſtinguiſhed from a ſucking lamb. The cry of this creature is nearly ſimilar to a young dog; and it is ſometimes interrupted by another cry ſimilar to that of the ſaki or fox-tailed monkey. It may be nouriſhed with the flour of manioc diluted in water.

Muſtella.

2. The lutra, or common otter, has naked feet, and the tail is about half the length of the body. It is in general about two feet long, from the tip of the noſe to the baſe of the tail. The fur is of a deep brown colour, with two ſmall white ſpots on each ſide of the noſe, and one beneath the chin. This animal inhabits Europe, North America, and Aſia as far ſouth as Perſia. It frequents freſh-water rivers, lakes, and fiſh-ponds; and preys on fiſh, frogs, and freſh-water cruſtaceous animals, being exceedingly deſtructive to fiſh-ponds. The otter procreates in February, and the female brings forth three or four young ones in May; the male calls the female by a ſoft murmuring noiſe. The otter ſhows great ſagacity in forming its habitation: it burrows under ground on the banks of ſome river or lake: it always makes the entrance of its hole under water; working upwards to the ſurface of the earth, and forming, before it reaches the top, ſeveral holes or lodges, that, in caſe of high floods, it may have a retreat: for no animal affects lying drier at top: it makes a minute orifice for the admiſſion of air. It is further obſerved, that this animal, the more effectually to conceal its retreat, contrives to make even this little air-hole in the middle of ſome thick buſh. Our author alſo informs us, that the otter is capable of being tamed; that he will follow his maſter like a dog, and even fiſh for him, and return with his prey. Though the otter does not caſt his hair, his ſkin is browner, and ſells dearer in winter than in ſummer; and makes a very fine fur. His fleſh has a diſagreeable fiſhy taſte. His retreats exhale a noxious odour from the remains of putrid fiſhes; and his own body has a bad ſmell. The dogs chace the otter ſpontaneouſly, and eaſily apprehend him when at a diſtance from water or from his hole. But, when ſeized, he defends himſelf, bites the dogs moſt cruelly, and ſometimes with ſuch force as to break their legbones, and never quits his hold but with life. The beaver, however, who is not a very ſtrong animal, purſues the otters, and will not allow them to live on the ſame banks with himſelf.

3. The lutreola, or ſmall otter, has very broad hairy feet, and a white mouth; and ſeldom exceeds a foot in length. The body is of a tawny and duſky colour mixed together; the fur having two ſeries of hairs, the ſhorter of which are yellowiſh and the long black. This animal inhabits Poland, Finland, Ruſſia, and Siberia; frequenting marſhy places, and preying

Muſtela. on fiſh and frogs. It is caught with dogs and traps, and is exceſſively fetid; but its fur is very valuable, being eſteemed next in beauty to that of the ſable.

Plate CCCXXXIII. 4. The canadenſis, or Canadian otter, is of a black colour, and the fur is ſmooth. It has a long taper tail; and inhabits Canada and other parts of North America.

5. The guianenſis, or ſmall Guiana otter, with the hind-feet webbed, the toes of the fore-feet unconnected, and a long taper naked tail, inhabits Cayenne, and probably other parts of South America. It is only about ſeven inches long from the noſe to the rump; the tail is near ſeven; the upper parts of the head and body are marked with large browniſh black ſpots, exactly correſponding on both ſides, and the intervals are of a yellowiſh grey colour; all the under parts of the body and head, and the fore-parts of the fore-legs, are white, and there is a white ſpot over each eye; the ears are large and round; and the mouth is garniſhed with long whiſkers. Buffon informs us that there are three ſpecies of otters in Cayenne: 1ſt, Black, which weighs from 40 to 50 French pounds. 2d, Yellowiſh, weighing 20 or 25 pounds. 3d, The ſmall greyiſh kind above deſcribed, which only weighs three or four pounds. The other two are not deſcribed; but they are ſaid to appear in numerous troops, to be very fierce and dangerous, and to defend themſelves againſt dogs, biting very cruelly: they litter in holes which they dig on the banks of rivers; are often tamed and brought up in houſes.

The otters, of which there are ſeveral more ſpecies deſcribed by authors, are diſtinguiſhed from the following tribe, the *weaſels*, by having their feet palmated or webbed; whereas the latter have their toes ſeparate, or unconnected by any web or membrane.

1. The galera, tayra, or Guinea weaſel, is of an uniform duſky colour, the fur very rough. It is about the ſize of a rabbit, and is ſhaped like a rat. It inhabits Guinea; where it burrows in the ground by means of its fore-feet, which are ſtrong and formed for digging. It is very common about the negro villages, and is exceedingly fierce and deſtructive to poultry.

2. The foina, or common martin, is of a blackiſh cheſnut colour, with the throat and breaſt white: the head and body meaſure 18 inches in length, the tail 10. The martin inhabits Britain, Germany, France, and moſt parts of the ſouth of Europe, and even the warmer parts of Ruſſia. He lives in woods, and goes about during the night in queſt of prey. He is a moſt elegant lively animal. His movements are all exceedingly nimble; he rather bounds and leaps than walks. He climbs rough walls with eaſe and alacrity; enters the pigeon or hen houſes, eats the eggs, pigeons, fowls, &c. and the female often kills great numbers, and tranſports them to her young. He likewiſe ſeizes mice, rats, moles, and birds in their neſts. M. Buffon kept one of theſe animals for a conſiderable time. He tamed to a certain degree, but never formed any attachment, and continued always ſo wild, that it was neceſſary to chain him. He made war againſt the rats, and attacked the poultry whenever they came in his way. He often got looſe, though chained by the middle of the body. At firſt he went to no great diſtance, and returned in a few hours; but without diſcovering any ſymptoms of joy or affection to any particular perſon. He, however, called for victuals like a cat or a dog. Afterwards he made longer excurſions; and at laſt he thought proper never to return. He was then about a year and a half old, ſeemingly the age at which nature aſſumes her full aſcendency. He eat every thing preſented to him, except ſallad and herbs; was fond of honey, and preferred hemp-ſeed to every other grain. It was remarked that he drank very often; that he ſometimes ſlept two days ſucceſſively, and at other times would ſleep none for two or three days; that, before ſleeping, he folded himſelf in a round form, and covered his head with his tail; and that, while awake, his motions were ſo violent, ſo perpetual, and ſo incommodious, that, though he had not diſturbed the fowls, it was neceſſary to chain him, to prevent him from breaking every thing. The ſame author informs us, that he has had in his poſſeſſion ſeveral martins of a more advanced age, which had been taken in nets; but they continued to be totally ſavage, bit all who attempted to touch them, and would eat nothing but raw fleſh. The character of this animal is ſomewhat differently given by Mr Pennant; who ſays "it is very *good-natured*, ſportive, and capable of being *tamed*." The younger females bring three or four at a birth; when older, they produce ſix or ſeven. They breed in hollows of trees; and are often, in winter, found in magpies neſts. The ſkin and excrements have a muſky ſmell. Muſtela.

3. The martes, or pine-martin, has the body of a dark or blackiſh cheſnut colour, the breaſt and throat yellow. It inhabits the north of Europe, Aſia, and America; and is more rarely found in Britain, France, Germany, and Hungary; and as far as Tonquin and China. They live in large woods or foreſts, keeping in the day-time in the hollows of trees, occupying ſquirrels neſts, eſpecially for their young, and go about only by night. They prey on ſquirrels, mice, rats, and ſmall birds; eat likewiſe berries, ripe fruit, and honey; and, in winter, go in queſt of pigeons and poultry. They procreate in February; and the female is ſaid, after nine months, to bring forth ſeven or eight young ones. The head of this ſpecies is ſhorter, and the legs are ſomewhat longer, than in the common martin. The fur is far ſuperior in fineneſs to that of the common kind, and is a prodigious article in commerce: Thoſe about Mount Caucaſus, with an orange throat, are more eſteemed by furriers than the reſt.

4. The Guiana or South American martin, is of a dark brown colour, with a white forehead, and a long narrow ſtripe along the ſide of the neck. The body and head are near two feet long, and the tail is only about five inches. It inhabits Guiana.

5. The laniger, woolly weaſel, or ſmall Guiana martin, is covered with white woolly hair, and has a long taper tail: the body and head are near 16 inches long, and the tail near 9. It inhabits Cayenne.

6. The zibellina, or ſable, has a great reſemblance to the martin: from which it differs in having a longer head; longer ears, ſurrounded by a yellow margin; longer and more elegant fur; the feet more thickly clothed with hair; and the tail ſhorter than the hind-legs when extended, while that of the martin is much longer. The colour of the hair is cinereous at the bottom, and black at the tips; the chin is cinereous, ſometimes white, yellowiſh, or ſpotted; the mouth is garniſhed with long whiſkers; and the feet are large, with white claws. It inhabits the northern parts of Aſia.

Muſtela. Aſia and America, Siberia, Kamtſchatka, and the Kurile iſlands, and formerly in Lapland; being found in Aſia as low as 58°, and in America even to 40° of latitude. The ſables frequent the banks of rivers and the thickeſt parts of the woods; avoiding the rays of the ſun, which are ſaid in a ſhort time to change the colour of their hair. They live in holes of the earth, or beneath the roots of trees: ſometimes they will form neſts in the trees, and ſkip with great agility from one to the other: they are very lively, and much in motion during the night. Gmelin tells us, that after eating, they generally ſleep half an hour or an hour, when they may be puſhed, ſhaken, and even pricked, without awaking. During the night they are exceſſively active and reſtleſs. A tame one kept by Gmelin was accuſtomed to riſe upon its hind-legs on ſight of a cat, in order to prepare for the combat: In the woods they are much infeſted by wild cats. During ſummer the ſables prey on ermines, weaſels, and ſquirrels, but eſpecially on hares; in winter, on birds; in autumn, on whortleberries, cranberries, and the berries of the ſervice-tree: but during this laſt ſeaſon their ſkins are at the worſt; that diet cauſing their ſkins to itch, and to rub off their fur againſt the trees. They bring forth at the end of March or beginning of April; and have from three to five at a time, which they ſuckle for four or five weeks. In ſpring, after ſhedding the coat, the fur is ſometimes of a tawny caſt, and ſometimes varies to ſnowy whiteneſs. The blackeſt are reputed the beſt; and ſometimes ſell, even in Siberia, from one to ten pounds Sterling each. See the article SABLE.

Plate CCCXXXIII. 7. The putorius, or pole-cat, is of a dirty yellow colour, with white muzzle and ears. He inhabits moſt parts of Europe, and in the temperate climates of Aſiatic Ruſſia; and has a great reſemblance to the martin in temperament, manners, diſpoſition, and figure. Like the latter, he approaches our habitations, mounts on the roofs, takes up his abode in hay-lofts, barns, and unfrequented places, from which he iſſues during the night only in queſt of prey. He burrows under ground, forming a ſhallow retreat about two yards in length, generally terminating under the roots of ſome large tree. He makes greater havock among the poultry than the martin, cutting off the heads of all the fowls, and then carrying them off one by one to his magazine. If, as frequently happens, he cannot carry them off entire, on account of the ſmallneſs of the entry to his hole, he eats the brains, and takes only the heads along with him. He is likewiſe very fond of honey, attacks the hives in winter, and forces the bees to abandon them. The females come in ſeaſon in the ſpring; and bring forth three, four, or five at a time. In the deſarts of Aſiatic Ruſſia, polecats are ſometimes found, eſpecially in winter, of a white colour; they are likewiſe found beyond lake Baikal with white or yellowiſh rumps, bounded with black. It is exceedingly fetid, like ſeveral other ſpecies of this genus, eſpecially the martin and ſable, giving out from the anus a moſt offenſive vapour when frightened. The male is moſtly of a yellowiſh tinge, having a whitiſh muzzle, while the muzzle of the female is commonly of a yellowiſh dirty white.

8. The furo, or ferret, has red and fiery eyes; the colour of the whole body is of a very pale yellow; the length from noſe to tail is about 14 inches, the tail five. In its wild ſtate it inhabits Africa: from thence it was brought into Spain, in order to free that country from multitudes of rabbits with which it was over-run; and from Spain the reſt of Europe has been ſupplied. This creature is incapable of bearing the cold, and cannot ſubſiſt even in France unleſs in a domeſtic ſtate. The ferret is not in our climates endowed with the ſame capacity of finding his ſubſiſtence as other wild animals, but muſt be carefully nouriſhed within doors, and cannot exiſt in the fields; for thoſe who are loſt in the burrows of rabbits never multiply, but probably periſh during the winter. Like other domeſtic animals, he varies in colour. The female ferret is leſs than the male; and when in ſeaſon, we are aſſured, ſhe is ſo extremely ardent, that ſhe dies if her deſires are not gratified. Ferrets are brought up in caſks or boxes, where they are furniſhed with beds of hemp or flax. They ſleep almoſt continually. Whenever they awake, they ſearch eagerly for food; and brawn, bread, milk, &c are commonly given them. They produce twice every year; and the female goes ſix weeks with young. Some of them devour their young as ſoon as they are brought forth, inſtantly come again in ſeaſon, and have three litters, which generally conſiſt of five or ſix, and ſometimes of ſeven, eight, or nine. They are employed for hunting rabbits; and as in this country they are apt to degenerate, warreners are in uſe to croſs the breed, procuring an intercourſe between a female ferret and a male polecat, by leaving the former, when in ſeaſon, near the haunts of the latter: The produce is of a much darker colour than the ferret, having a great reſemblance to the polecat. This animal is by nature a mortal enemy to the rabbit. Whenever a dead rabbit is for the firſt time preſented to a young ferret, he flies upon it, and bites it with fury; but if it be alive, he ſeizes it by the throat or the noſe, and ſucks its blood. When let into the burrows of rabbits, he is muzzled, that he may not kill them in their holes, but only oblige them to come out, in order to be caught in the nets. If the ferret is let in without a muzzle, he is in danger of being loſt: for, after ſucking the blood of the rabbit, he falls aſleep; and even ſmoking the hole is not a certain method of recalling him; becauſe the holes have often ſeveral entries which communicate with each other, and the ferret retires into one of thoſe when incommoded with the ſmoke. Boys likewiſe uſe the ferret for catching birds in the holes of walls, or of old trees. The ferret, tho' eaſily tamed, and rendered docile, is extremely iraſcible: his odour is always diſagreeable; but when he is irritated, it becomes much more offenſive. His eyes are lively, and his aſpect is inflammatory; all his movements are nimble; and he is at the ſame time ſo vigorous, that he can eaſily maſter a rabbit, tho' at leaſt four times larger than himſelf.

9. The ſarmatica, or Sarmatian weaſel, is of a browniſh black colour, ſpotted and ſtriped irregularly with obſcure yellow, and is about 14 inches in length, excluſive of the tail, which is ſix inches in length. It reſembles the polecat, but has a narrower head, a more lengthened body, a longer tail, and ſhorter hair, except on the feet and tail; inhabits Poland, eſpecially Volhynia, in the deſerts of Ruſſia between the Volga and Tanais, the mountains of Caucaſus, Georgia, and Bucharia.

Muſtella. charia. This is a moſt voracious animal, which feeds on marmots, rats, mice, jerboas, birds, and other ſmall animals. It procreates in ſpring, and after eight weeks the female, which has eight teats, brings forth from four to eight young ones. It lives in holes, ſometimes of its own burrowing, but moſtly in thoſe which have been made by other animals, and is exceedingly fetid.

Plate CCCXXXIII. 10. The vulgaris, or common weaſel, foumart, or whitret, has the upper parts of the body of a pale reddiſh brown; the lower parts white. It inhabits the temperate and northern parts of Europe, Aſia, and America, and as far to the ſouthward as the northern provinces of Perſia, and is ſaid to be found even in Barbary. In the more northern parts of Ruſſia and Sweden, particularly in Weſtbothnia, it becomes white in winter like the ermine; but even in this ſtate it is eaſily diſtinguiſhable from the latter, being a great deal ſmaller; the body and head not exceeding ſeven inches long, and the tail two inches and a half. It is very deſtructive to young birds, poultry, and young rabbits; and is beſides a great devourer of eggs. It does not eat its prey on the place; but, after killing it by one bite near the head, carries it off to its young, or to its retreat. It preys alſo on moles, as appears by its being ſometimes caught in the mole-traps. It is a remarkably active animal; and will run up the ſides of walls with ſuch eaſe, that ſcarce any place is ſecure from it; and the body is ſo ſmall, that there is ſcarce any hole but what is pervious to it.—This ſpecies is much more domeſtic than any of the reſt, and frequents out-houſes, barns, and granaries. It clears its haunt in a ſhort time from mice and rats, being a much greater enemy to them than the cat itſelf. In ſummer, however, they retire farther from houſes, eſpecially into low grounds, about mills, along rivulets, concealing themſelves among bruſh-wood, in order to ſurpriſe birds; and often take up their abode in old willows, where the female brings forth her young. She prepares for them a bed of ſtraw, leaves, and other herbage, and litters in the ſpring, bringing from ſix to eight or more at a time. The young are born blind; but ſoon acquire ſight and ſtrength ſufficient to follow their mothers. Their motion conſiſts of unequal and precipitant leaps; and when they want to mount a tree, they make a ſudden bound, by which they are at once elevated ſeveral feet high. They leap in the ſame manner when they attempt to ſeize a bird. Theſe creatures, as well as the pole-cat and ferret, have a diſagreeable odour, which is ſtronger in ſummer than in winter; and when purſued or irritated, their ſmell is felt at a conſiderable diſtance. They move always with caution and ſilence, and never cry but when they are hurt. Their cry is ſharp, rough, and very expreſſive of reſentment. As their own odour is offenſive, they ſeem not to be ſenſible of a bad ſmell in other bodies. M. Buffon informs us, that a peaſant in his neighbourhood took three new-littered weaſels out of the carcaſe of a wolf that had been hung up on a tree by the hind-feet. The wolf was almoſt entirely putrefied, and the female weaſel had made a neſt of leaves and herbage for her young in the thorax of this putrid carcaſe. The weaſel may be perfectly tamed, and rendered as careſſing and frolickſome as a dog or ſquirrel. The method of taming them is to ſtroke them often and gently over the back; and to threaten, and even to beat them when they bite. In the domeſtic ſtate their odour is never offenſive but when irritated. They are fed with milk, boiled fleſh, and water. Muſtella.

11. The erminea, or ermine, has the tail tipt with black, and has been diſtinguiſhed by authors into two varieties, the *ſtoat* and the *white ermine*, though the difference ſeems chiefly to depend on climate and the ſeaſon of the year; the ſtoat of a pale tawny brown or reddiſh yellow colour in ſummer, becoming the white ermine of winter in cold countries. They inhabit the north of Europe, Aſia, and America, and as far as the northern parts of Perſia and China; living in heaps of ſtones on the banks of rivers, in the hollows of trees, and particularly in foreſts, eſpecially thoſe of beech, preying on ſquirrels and lemmings. In manners and food this animal reſembles the common weaſel, but does not frequent houſes, haunting chiefly in woods and hedges, eſpecially ſuch as border on brooks or rivulets. In general appearance it comes very near to the martin, but is ſhorter in the body, being ſcarcely ten inches long from noſe to rump, and the tail about five and a half; the hair is likewiſe ſhorter and leſs ſhining than in that animal. In the northern regions, the fur of the ermine becomes entirely white during winter, except the outer half of the tail, which remains black. The ſkin is reckoned valuable, and ſells in Siberia from two to three pounds Sterling a-hundred; but in ancient times it was in much greater requeſt than now. In ſummer, the upper part of the body is of a pale tawny brown colour; the edges of the ears, and ends of the toes, are yellowiſh white; the throat, breaſt, and belly are white; in winter, in the more temperate regions, it is ſometimes mottled with brown and white; but in more ſevere winters becomes entirely white; the farther north and the more rigorous the climate, the white is the purer; thoſe of Britain generally retain a yellowiſh tinge. In Perſia and other more ſouthern parts, it is brown the whole year In Siberia they burrow in the fields, and are taken in traps baited with fleſh. In Norway they are either ſhot with blunt arrows, or taken in traps made of two flat ſtones, one being propped up with a ſtick, to which is faſtened a baited ſtring, which when the animals nibble, the ſtone falls down and cruſhes them to death. The Laplanders take them in the ſame manner, only inſtead of ſtones make uſe of two logs of wood.

There are about 12 other ſpecies of the weaſel tribe deſcribed by authors.—A beautiful ſpecies of *weaſel*, as it is called by ſome authors and univerſally conſidered by the Arabians, is deſcribed by Mr Bruce in his Appendix under the name of *El Fennec*. It is about ten inches long from the ſnout to the tail; the tail near five inches and a quarter, and about half an inch of it black at the tip. From the point of the fore-ſhoulder to the point of the fore-toe it is two inches and ſeven eighths; from the occiput to the point of the noſe, two inches and a half; and the ears are three inches and three eighths in length; and about an inch and a half in breadth, with the cavities very large. They are doubled, and have a plait on the outſide; the border of the inſide is thick and covered with white ſoft hair, the middle part being bare and of a roſe or pink colour. The pupil of the

eye

Mustella.

Plate CCCXXXIII.

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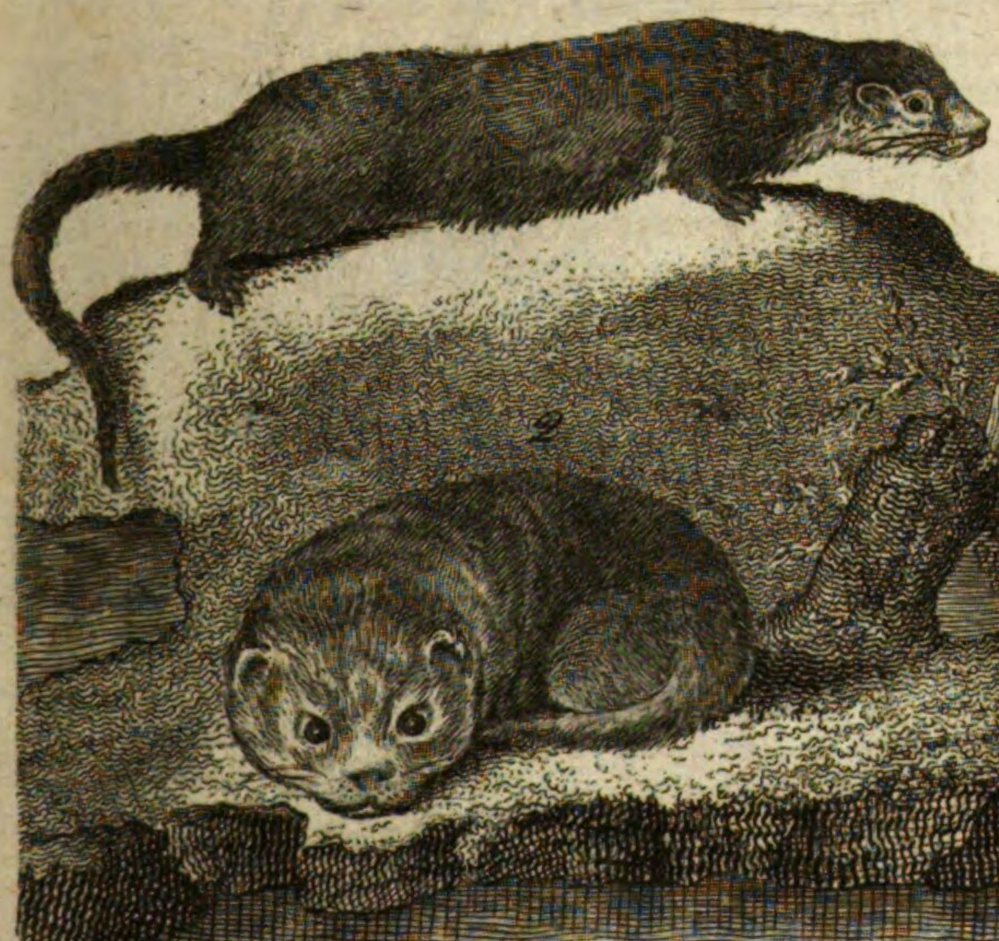

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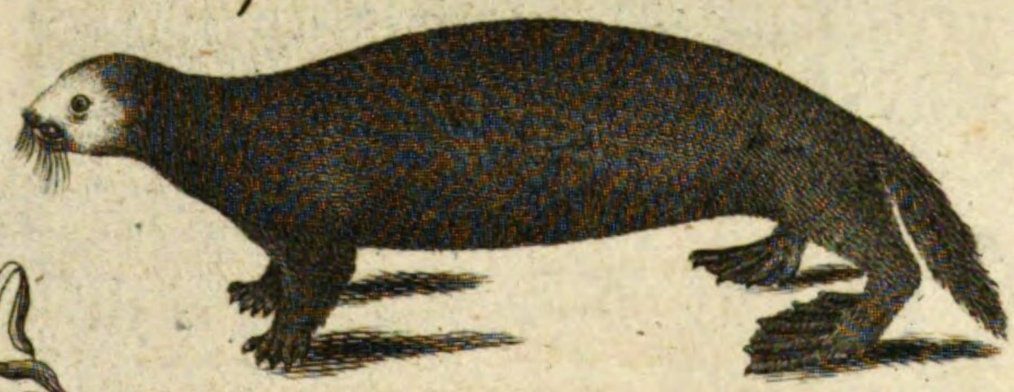

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A. Bell Prin. Mal. Sculptor. fecit.

Muſtella. eye is large and black, ſurrounded with a deep blue iris; the muſtachoes are thick and ſtrong; the tip of the noſe is very ſharp, black, and poliſhed. There are four grinders on each ſide of the mouth, ſix fore teeth in each jaw, and the upper jaw projected beyond the lower one. The canine teeth are large, long, and very ſharp-pointed; the legs ſmall, and the feet broad, with four toes armed with ſhort, black, ſharp retractile claws; thoſe on the fore-feet being ſharper than thoſe behind. The whole body of the animal is of a dirty white, approaching to cream colour; the hair of the belly rather whiter, longer, and ſofter than the reſt, with a number of paps upon it.

Mr Bruce obtained one of theſe animals for two ſequins, by means of a janiſary, who had it from a Turkiſh foot-ſoldier juſt returned from Biſcara, a ſouthern diſtrict of Mauritania Cæſarienſis, now called the *Province of Conſtantina*. According to his account, they are not uncommon in this diſtrict, though more frequently to be met with in the neighbouring date-territories of Beni Mezab and Werglab, the reſidence of the ancient Melano-Gætuli. In the Werglab the animals are hunted for their ſkins, which are ſold at Mecca, and afterwards exported to India. Mr Bruce kept this one for ſeveral months at his country-houſe near Algiers, that he might learn its manners. Its favourite food he tells us was dates or other ſweet fruit, yet it is alſo very fond of eggs. It devoured thoſe of pigeons and ſmall birds with great avidity when firſt brought to him; but did not ſeem to know how to manage hen's eggs, though when they were broken to him he ate the contents with as great avidity as the others. When hungry, he would eat bread, eſpecially with honey or ſugar. His attention was greatly engroſſed by the ſight of any bird flying acroſs the room where he was, or confined in a cage near him, and could not be diverted from viewing it by placing biſcuit before him; ſo that it ſeems probable, that he preys upon them in his wild ſtate. He was extremely impatient of having his ears touched; ſo that it was with much difficulty that they could be meaſured; and, on account of this impatience, it was found impoſſible to count the protuberances or paps on his belly. He ſeemed very much frightened at the ſight of a cat; and endeavoured to hide himſelf, though he did not appear to meditate any defence. On this occaſion alſo he lowered his ears, which at other times he kept erect. Notwithſtanding his impatience, he would ſuffer himſelf, though with difficulty, to be handled in the day-time; but in the night he was extremely reſtleſs, always endeavouring to make his eſcape; and though he did not attempt the wire, yet with his ſharp teeth he would ſoon have made his way through a wooden one, as two others which they attempted to bring along with him actually did. Theſe animals are very ſwift of foot. They build their neſts in trees, particularly the palms, of which they eat the fruit; feeding alſo on locuſts and other inſects, and perhaps ſometimes preying upon ſmall birds. Mr Bruce has a long criticiſm on Dr Sparmann for pretending that one Mr Brander was the diſcoverer of this animal, whereas he ſays that he himſelf gave it to Mr Brander. This is the ſame animal with that formerly deſcribed as a ſpecies of CANIS† under the name of *zerda*, and of which a figure is given in Plate CXX. Its exact place in the zoological ſyſtem has not yet been aſcertained.

† See *Canis*, n° xiv.

MUSTER, in a military ſenſe, a review of troops under arms, to ſee if they be complete and in good order; to take an account of their numbers, the condition they are in, viewing their arms and accoutrements, &c. Muſter Mutilation.

MUSTER-Maſter-general, or *Commiſſary-general of the MUSTERS*; one who takes account of every regiment, their number, horſes, arms, &c. reviews them, ſees the horſes be well mounted, and all the men well armed and accoutred, &c.

MUSTER-Rolls, liſts of ſoldiers in each company, troop, or regiment, by which they are paid, and the ſtrength of the army is known.

MUTABILITY is oppoſed to immutability. See IMMUTABILITY.

MUTATION, the act of changing, or ſometimes the change itſelf.

MUTATION, in the ancient muſic, is applied to the changes or alterations that happen in the order of the ſounds which compoſe the melody.

MUTATIONES, among the Romans, poſt ſtages, or places where the public couriers were ſupplied with freſh horſes.—The *mutationes* were wholly deſigned for the uſe of theſe couriers, or meſſengers of ſtate; in which reſpect they differ from *manſiones*.

MUTCHKIN, a liquid meaſure uſed in Scotland; it contains four gills, and is the fourth part of a Scotch pint.

MUTE, in a general ſenſe, ſignifies a perſon that cannot ſpeak, or has not the uſe of ſpeech.

MUTE, in law, a perſon that ſtands dumb or ſpeechleſs, when he ought to anſwer, or to plead. See ARRAIGNMENT.

MUTE, in grammar, a letter which yields no ſound without the addition of a vowel. The ſimple conſonants are ordinarily diſtinguiſhed into mutes and liquids, or ſemi-vowels. See the articles CONSONANT, LIQUID, &c.

The mutes in the Greek alphabet are nine, three of which, viz. π, κ, τ, are termed *tenues*; three β, γ, δ, termed *mediæ*; and three φ, χ, θ, termed *aſpirates*. See the article ASPIRATE, &c.

The mutes of the Latin alphabet are alſo nine, viz. B, C, D, G, I, K, P, Q, T.

MUTILATION, the retrenching or cutting away any member of the body.

This word is alſo extended to ſtatues and buildings, where any part is wanting, or the projecture of any member, as a cornice or an impoſt, is broken off. It is ſometimes alſo uſed in a more immediate manner for caſtration: (See CASTRATION and EUNUCH). The practice of this ſort of mutilation is of various kinds: The Hottentots are ſaid to cut away one teſticle from their children, upon ſuppoſition that they are thereby made lighter and more active for running. In other countries, poor people completely mutilate their boys, to prevent the miſery and want which would attend their offspring. Thoſe who have nothing in view but the improvement of a vain talent, or the formation of a voice which diſfigures nature, as was the caſe formerly in Italy, are contented with cutting away the teſticles. But in ſome countries of Aſia, eſpecially among the Turks and in a part of Africa, thoſe whom

Mutilation.

jealouſy inſpires with diſtruſt, would not think their wives ſafe in the cuſtody of ſuch eunuchs: They employ no ſlaves in their ſeraglios who have not been deprived of all the external parts of generation.

Amputation is not the only means of accompliſhing this end. Formerly, the growth of the teſticles was prevented, and their organization deſtroyed, by ſimple rubbing, while the child was put into a warm bath made of a decoction of plants. Some pretend that by this ſpecies of caſtration the life is in no danger. Amputation of the teſticles is not attended with much danger; but complete amputation of the external parts of generation is often fatal. This operation can only be performed on children from ſeven to ten years of age. Eunuchs of this kind, owing to the danger attending the operation, coſt in Turkey five or ſix times more than others. *Chardin* relates, that this operation is ſo painful and dangerous after 15 years of age, that hardly a fourth part of thoſe by whom it is undergone eſcape with life. *Pietro della Valle*, on the contrary, informs us, that in Perſia thoſe who ſuffer this cruel and dangerous operation as a puniſhment for rapes and other crimes of this kind, are eaſily cured though far advanced in life; and that nothing but aſhes is applied to the wound.

There are eunuchs at Conſtantinople, throughout all Turkey, and in Perſia, of a grey complexion: they come for the moſt part from the kingdom of Golconda, the peninſula on this ſide the Ganges, the kingdoms of Aſſau, Aracan, Pegu, and Malabar. Thoſe from the gulph of Bengal are of an olive colour. There are ſome white eunuchs who come from Georgia and Circaſſia, but their number is ſmall. The black eunuchs come from Africa, and eſpecially from Ethiopia. Theſe, in proportion to their horrible appearance, are the more eſteemed and coſt dearer. It appears that a very conſiderable trade is carried on in this ſpecies of men; for Tavernier informs us, that when he was in the kingdom of Golconda in the year 1657, 22,000 eunuchs were made in it. In that country they are ſold at the fairs.

Eunuchs who have been deprived only of their teſticles, continue to feel a titillation in what remains, and to have the external ſign even more frequently than other men. But the part which remains is very ſmall, and continues almoſt in the ſame ſtate in which it was when the operation was performed during childhood.

If the different kinds of eunuchs are examined with attention, it will be found almoſt univerſally, that caſtration and its conſequences have produced greater or leſs changes on their ſhape and appearance, independent of its phyſical effects.

Eunuchs, ſays M. Withof, are timid, irreſolute, fearful, ſuſpicious, and unſteady: And this ſeems to hold generally, though not univerſally, or without exceptions; (ſee the article Eunuch). The reaſon is, that their blood has not received all the neceſſary preparation in paſſing through the ſpermatic veſſels. Thus being deprived of the properties of males, they participate of the diſpoſitions of females, and their very ſoul is of an intermediate ſex. They are not, however, without advantages: They become larger and fatter than other men; but they ſometimes grow to a diſguſting ſize. Though oily ſubſtances are more abundant in eunuchs, they are likewiſe leſs ſubject to gout and to madneſs than men who have a greater quantity of blood and of ſplenetic humours. The abundant circulation of oily liquor prevents roughneſs or inequalities in the trachea and palate. This, joined to the flexibility of the epiglottis and of the other organs of the voice, makes it ſo ſonorous and extenſive, and at the ſame time ſo ſweet, that it is almoſt impoſſible for eunuchs to pronounce diſtinctly the letter R. Is this factitious advantage a ſufficient conſolation to theſe unhappy men for the barbarity of thoſe who have dared to ſacrifice nature at the ſhrine of avarice? It is impoſſible to reflect on all the motives for making eunuchs without a ſigh of pity and regret; and yet it muſt not be ſuppoſed that this abominable cruelty is always infallibly attended with that advantage which is ſometimes expected from it. Of 2000 victims to the luxury and extravagant caprices of the art, hardly three are found who unite good talents with good organs. The other languiſhing and inactive wretches, are outcaſts from both ſexes, paralytic members in the community, an uſeleſs burden upon the earth, by which they are ſupported and nouriſhed. But let us pay the tribute which is due to that virtuous pontiff Pope Clement VIII. who, liſtening to the voice of modeſty and humanity, proſcribed and aboliſhed this deteſtable and infamous practice. Mutilation he declared was the moſt abominable and diſgraceful of crimes.

Muſilla || Mutiny.

MUTILLA, in zoology, a genus of animals belonging to the order of inſecta hymenoptera. There are 10 ſpecies; the moſt remarkable of which is the occidentalis, or velvet ant, an inhabitant of North America. It has ſix legs, with ſhort crooked antennæ; the abdomen large, with a black liſt croſſing the lower part of it, and another black ſpot at the joining of the thorax; excepting which, the whole body and head reſembles crimſon-velvet. The trunk or ſhell of the body is of ſuch a ſtrong and hard contexture, that though trod upon by men and cattle they receive no harm. They have a long ſting in their tails, which cauſes inflammation and great pain for half an hour to thoſe who are ſtung by them; which uſually happens to negroes and others that go barefooted. They are moſtly ſeen running very nimbly on ſandy roads in the hotteſt ſummer-weather; and always ſingle. What they feed on, in what manner they breed, and where they ſecure themſelves in winter, is unknown.

MUTINA (anc. geog.), a noble city of the Ciſpadana, made a Roman colony in the ſame year with Parma, ſituated between the rivers Gabellus and Scultenna, on the Via Æmilia. Here D. Brutus, being beſieged by Antony, was relieved by the conſuls Hirtius and Panſa. The Greeks called it *Mutine;* except Polybius, in whom it is *Motine;* and in Ptolemy *Mutina*, after the Roman manner.—Now *Modena*, a city of Lombardy, and capital of a cognominal duchy. E. Long. 11. 20. N. Lat. 44. 45.

MUTINY, in a military ſenſe, to riſe againſt authority.—"Any officer or ſoldier who ſhall preſume to uſe traiterous or diſreſpectful words againſt the ſacred perſon of his majeſty, or any of the royal family, is guilty of mutiny.

"Any officer or ſoldier who ſhall behave himſelf

Mutiny || Mutton.

with contempt or diſreſpect towards the general. or other commander in chief of our forces, or ſhall ſpeak words tending to their hurt or diſhonour, is guilty of mutiny.

"Any officer or ſoldier who ſhall begin, excite, cauſe, or join in, any mutiny or ſedition, in the troop, company, or regiment, to which he belongs, or in any other troop or company in our ſervice, or on any party, poſt, detachment, or guard, on any pretence whatſoever, is guilty of mutiny.

"Any officer or ſoldier who, being preſent at any mutiny or ſedition, does not uſe his utmoſt endeavours to ſuppreſs the ſame, or coming to the knowledge of any mutiny, or intended mutiny, does not without delay give information to his commanding officer, is guilty of mutiny.

"Any officer or ſoldier who ſhall ſtrike his ſuperior officer, or draw, or offer to draw, or ſhall lift up any weapon, or offer any violence againſt him, being in the execution of his office, on any pretence whatſoever, or ſhall diſobey any lawful command of his ſuperior officer, is guilty of mutiny."

Mutiny-Act. See *Military-State.*

MUTIUS (Caius), ſurnamed *Codrus*, and afterwards *Scævola*, was one of the illuſtrious Roman family of the Mutians, and rendered his name famous in the war between Porſenna king of Tuſcany and the Romans. That prince reſolving to reſtore the family of Tarquin the Proud, went to beſiege Rome 507 B. C. Mutius reſolved to ſacrifice himſelf for the ſafety of his country; and boldly entering the enemy's camp, killed Porſenna's ſecretary, whom he took for Porſenna himſelf. Being ſeized and brought before Porſenna, he told him boldly, that 300 young men like himſelf had ſworn to murder him; *but ſince this hand has miſſed thee*, continued he, *it muſt be puniſhed;* then putting his right hand on the burning coals, he let it burn with ſuch a conſtancy as aſtoniſhed the beholders. The king, amazed at the intrepidity of this young Roman, ordered that he ſhould have his freedom and return to Rome, and ſoon after concluded a peace with the Romans. From this action Mutius obtained the ſurname of *Scævola*, "or left-handed," which was enjoyed by his family.

Mutius Scævola (Q.), ſurnamed the *Augur*, was an excellent civilian, and inſtructed Cicero in the laws. He was made prætor in Aſia; was afterwards conſul, and performed very important ſervices for the republic.

He ought not to be confounded with *Quintus Mutius Scævola*, another excellent civilian, who was prætor in Aſia, tribune of the people, and at length conſul, 95 B. C. He governed Aſia with ſuch prudence and equity, that his example was propoſed to the governors who were ſent into the provinces. Cicero ſays, "that he was the moſt eloquent orator of all the civilians, and the moſt able civilian of all the orators." He was aſſaſſinated in the temple of Veſta, during the wars of Marius and Sylla, 82 B. C.

MUTTON, the common name of the fleſh of a ſheep after the animal has been killed. Mutton has been commonly preferred to all the fleſhes of quadrupeds. And indeed, beſides its being more perfect, it has the advantage over them of being more generally ſuited to different climates: whereas beef, *e. g.* requires a very nice intermediate ſtate, which it ſeems to enjoy chiefly in England; for although Scotland ſupplies what are reckoned the beſt cattle, it is in the rich Engliſh paſtures that they are brought to perfection. Now the ſheep can be brought almoſt to the ſame perfection in this bleak northern region as in the ſouthern countries.

Mutual || Mya.

MUTUAL, a relative term, denoting ſomething that is reciprocal between two or more perſons.

Thus we ſay, *mutual aſſiſtance*, *mutual averſion*, &c. There are mutual or reciprocal duties, offices, &c. between ſuperiors and inferiors; as the king and his ſubjects, the maſter and his ſervants, &c.

Vaugelas makes a diſtinction between *mutual* and *reciprocal*: *mutual*, according to him, is underſtood of what is between two only; and *reciprocal*, of what is between more than two: but this diſtinction is little regarded in common uſe.

MUTULE, in architecture, a kind of ſquare modillion ſet under the cornice of the Doric order.

MUTUNUS, or Mutinus (fab. hiſt.), a deity among the Romans, much the ſame as the Priapus of the Greeks. The Roman matrons, and particularly newly married women, diſgraced themſelves by the obſcene ceremonies which cuſtom obliged them to obſerve before the ſtatue of this impure deity.

MUZZLE *of a* Gun *or* Mortar, the extremity at which the powder and ball is put in; and hence the muzzle-ring is the metalline circle or moulding that ſurrounds the mouth of the piece.

MYA, the Gaper, in zoology; a genus belonging to the order of vermes teſtacea, the characters of which are theſe. It has a bivalve ſhell gaping at one end; the hinge, for the moſt part, furniſhed with a thick, ſtrong, and broad tooth, not inſerted into the oppoſite valve. Its animal is an Ascidia. The moſt remarkable ſpecies are.

1. The declivis, or ſloping mya, has a brittle half-tranſparent ſhell, with a hinge ſlightly prominent near the open, and ſloping downwards. It inhabits the rivers of Europe. It is frequent about the Hebrides; the fiſh eaten there by the gentry. Plate CCCXXXV. fig. 1.

2. The mya pictorum has an oval brittle ſhell, with a ſingle longitudinal tooth like a lamina in one ſhell, and two in the other; the breadth is a little above two inches, the length one. It inhabits rivers. The ſhells are uſed to put water-colours in, whence the name. Otters feed on this and the other freſh-water ſhells. Fig. 2.

3 The margaritifera, or pearl mya, has a very thick, coarſe, opaque ſhell; often much decorticated; oblong, bending inward on one ſide, or arcuated; black on the outſide; uſual breadth from five to ſix inches, length two and a quarter. It inhabits great rivers, eſpecially thoſe which water the mountainous parts of Great Britain.—This ſhell is noted for producing quantities of pearl. There have been regular fiſheries for the ſake of this precious article in ſeveral of our rivers. Sixteen have been found within one ſhell. They are the diſeaſe of the fiſh, analogous to the ſtone in the human body. On being ſqueezed, they will eject the pearl, and often caſt it ſpontaneouſly in the ſand of the ſtream. The river Conway was noted for them in the days of Cambden. A notion alſo prevails, that Sir Richard Wynne of Gwydir, chamberlain to Catha- Fig. 3. & 4.

Mya. rine queen to Charles II. preſented her majeſty with a pearl (taken in this river) which is to this day honoured with a place in the regal crown. They are called by the Welſh *cregin diluw*, or "deluge ſhells," as if left there by the flood. The Irt in Cumberland was alſo productive of them. The famous circumnavigator, Sir John Hawkins, had a patent for fiſhing in that river. He had obſerved pearls plentiful in the Straits of Magellan, and flattered himſelf with being enriched by procuring them within his own iſland. In the laſt century, ſeveral of great ſize were got in the rivers of the counties of Tyrone and Donegal in Ireland. One that weighed 36 carats was valued at 40 l. but being foul, loſt much of its worth. Other ſingle pearls were ſold for 4 l. 10 s. and even for 10 l. The laſt was ſold a ſecond time to Lady Glenlealy, who put it into a necklace, and refuſed 80 l. for it from the ducheſs of Ormond. Suetonius reports, that Cæſar was induced to undertake his Britiſh expedition for the ſake of our pearls; and that they were ſo large that it was neceſſary to uſe the hand to try the weight of a ſingle one. Mr Pennant ſuppoſes that Cæſar only heard this by report; and that the cryſtalline balls called *mineral pearl*, were miſtaken for them. We believe that Cæſar was diſappointed of his hope: yet we are told that he brought home a buckler made with Britiſh pearl, which he dedicated to, and hung up in, the temple of Venus Genetrix: a proper offering to the goddeſs of beauty, who ſprung from the ſea. It may not be improper to mention, that notwithſtanding the claſſics honour our pearl with their notice, yet they report them to have been ſmall and ill-coloured, an imputation that in general they are ſtill liable to. Pliny ſays, that a red ſmall kind was found about the Thracian Boſphorus, in a ſhell called *mya;* but does not give it any mark to aſcertain the ſpecies.

Linnæus made a remarkable diſcovery relating to the generation of pearls in this fiſh.—It is a fiſh that will bear removal remarkably well; and it is ſaid, that in ſome places they form reſervoirs for the purpoſe of keeping it, and taking out the pearl, which, in a certain period of time, will be again renewed. From obſervations on the growth of their ſhells, and the number of their annular laminæ or ſcales, it is ſuppoſed the fiſh will attain a very great age; 50 or 60 years are imagined to be a moderate computation. The diſcovery turned on a method which Linnæus found, of putting theſe ſhell-fiſh into a ſtate of producing pearls at his pleaſure; though the final effect did not take place for ſeveral years: He ſays, that in five or ſix years after the operation, the pearl would have acquired the ſize of a vetch. We are unacquainted with the means by which he accompliſhed this extraordinary operation; but it was probably publiſhed at the time, and conſidered as important, ſince it is certain that the author was rewarded with a munificent premium from the ſtates of the kingdom on this account. We regret that we cannot ſpeak more fully on this head; but may obſerve, that it is probable, from a paper publiſhed many years afterwards in the Berlin Acts, that the method conſiſted in injuring the ſhell externally, perhaps by a perforation; as it has been obſerved, that theſe concretions in ſhell-fiſh are found on the inſide, exactly oppoſite to perforations and injuries made from without by ſerpulæ and other animals.

MYAGRUM, Gold of Pleasure, in botany: A genus of the ſiliculoſa order, belonging to the tetradynamia claſs of plants; and in the natural method ranking under the 39th order, *Siliquoſæ*. The ſilicula is terminated by an oblong ſtyle; the cell generally monoſpermous. There are five ſpecies; but the only remarkable one is the ſativum, which grows naturally in corn-fields in the ſouth of France and Italy, and alſo in ſome parts of Britain. It is an annual plant, with an upright ſtalk a foot and an half high, ſending out two or four ſide-branches, which grow erect; the flowers grow in looſe ſpikes at the end of the branches, ſtanding upon ſhort footſtalks an inch long; they are compoſed of four ſmall yellowiſh petals, placed in form of a croſs; theſe are ſucceeded by oval capſules, which are bordered and crowned at the top with the ſtyle of the flower, having two cells filled with red ſeeds.— This is cultivated in Germany for the ſake of the expreſſed oil of the ſeeds, which the inhabitants uſe for medicinal, culinary, and œconomical purpoſes. The ſeeds are a favourite food with geeſe. Horſes, goats, ſheep, and cows, eat the plant. Myagrum ‖ Mycetites

MYCALE, a city and mountain of Caria; alſo a promontory of Aſia oppoſite Samos, celebrated for a battle which was fought there between the Greeks and Perſians about the year of Rome 275. The Perſians were about 100,000 men, who had juſt returned from the unſucceſsful expedition of Xerxes in Greece.— They had drawn their ſhips to the ſhore, and fortified themſelves ſtrongly, as if determined to ſupport a ſiege. They ſuffered the Greeks to diſembark from their fleet without the leaſt moleſtation, and were ſoon obliged to give way before the cool and reſolute intrepidity of an inferior number of men. The Greeks obtained a complete victory, ſlaughtered ſome thouſands of the enemy, burned their camp, and ſailed back to Samos with an immenſe booty, in which were 70 cheſts of money.

MYCENÆ (anc. geog.) a town of Argolus, in Peloponneſus. The kingdom of the Argives was divided into two portions by Acriſius and his brother Prœtus. Argos and Mycenæ were their capitals.— Theſe, as belonging to the ſame family, and diſtant only about 50 ſtadia or ſix miles and a quarter from each other, had one tutelary deity, Juno, and were jointly proprietors of her temple, the Heræum, which was near Mycenæ. It was here that Agamemnon reigned. He enlarged his dominions by his valour and good fortune, and poſſeſſed, beſides Mycenæ, the region about Corinth and Sicyon, and that called afterwards Achæa. On his return from Troy, he was ſlain with his companions at a banquet. Mycenæ then declined; and under the Heraclidæ was made ſubject to Argos. (See Argos and Argeia.) The Mycenæans, ſending 80 men, partook with the Lacedæmonians in the glory acquired at Thermopylæ. The jealouſy of the Argives produced the deſtruction of their city, which was abandoned after a ſiege, and laid waſte in the firſt year of the 78th Olympiad, or 466 years before Chriſt. Some part of the wall remained in the ſecond century, with a gate, on which were lions, a fountain, the ſubterraneous edifices where Atreus and his ſons had depoſited their treaſures and, among other ſepulchral monuments, one of Agamemnon, and one of his fellow-ſoldiers and ſufferers.

MYCETITES discoides, in natural hiſtory, a name

Mycone || Mycteria.

name given by Dr Woodward to thoſe kinds of foſſile coralloide bodies which the generality of writers had called, after Dr Plott, *porpitæ*. Theſe are uſually ſmall, and of a roundiſh, but flatted figure; they are hollowed on one ſide with a ſort of umbilicus, and ſtriated on the other; they are found on the ploughed lands in Oxfordſhire, and ſome other of our midland counties, and in other places, buried in the ſolid ſtrata of ſtone; they are ſometimes yellowiſh, ſometimes browniſh, and are from the breadth of an inch to a fourth part or leſs of that ſize; when broken, they are uſually found to conſiſt of a kind of ſpar, not unlike that of which the ſhelly coats of the echinitæ, or the lapides indici, and other ſpines of echini conſiſt in their foſſile ſtate; and in ſome of them the ridges and ſtriæ are thick ſet with little knobs and tubercles. The baſis in ſome of theſe is flat, as it is in others riſing in form of a circular elevation from the umbilicus, and others have a circular cavity in the ſame place.

MYCONE, an iſland of the Archipelago, ſituated in E. Long. 25. 51. N. Lat. 37. 28. It is about 36 miles in circuit, and has a town of the ſame name, containing about 3000 inhabitants. The people of this iſland are ſaid to be the beſt ſailors in the Archipelago, and have about 150 veſſels of different ſizes. The iſland yields a ſufficient quantity of barley for the inhabitants, and produces abundance of figs, and ſome olives; but there is a ſcarcity of water, eſpecially in ſummer, there being but one well on the iſland.—There are a great number of churches and chapels, with ſome monaſteries. The dreſs of the women in this iſland is very remarkable, and as different from that of the other iſlands as that of thoſe iſlanders is different from the dreſs of the other European ladies. Their heads are adorned with lively-coloured turbans; their garments are a ſhort white ſhift plaited before and behind, which reaches to their knees; they have white linen-drawers, and red, green, yellow, or blue ſtockings, with various coloured ſlippers. An ordinary ſuit for the better ſort will coſt 200 crowns.

MYCONUS (anc. geog.) one of the iſlands called Cyclades, near Delos, under which the laſt of the Centaurs ſlain by Hercules are feigned to lie buried. Hence the proverb, *Omnia ſub unam Myconum congerere*, applied to an injudicious or unnatural farrago. Myconii, the people, noted for baldneſs. Hence Myconius, a bald perſon. According to Strabo, the inhabitants became bald at the age of 20 or 25; and Pliny ſays that the children were always born without hair. The iſland was poor, and the inhabitants very avaricious; whence Archilochus reproached a certain Pericles, that he came to a feaſt like a Myconian; that is, without previous invitation. Now called *Mycone*, an iſland in the Archipelago. E. Long. 25° 6′. Lat. 37°.

Plate CCCXXXV.

MYCTERIA, the Jabiru, in ornithology; a genus of birds belonging to the order of grallæ. The bill is long, bending upwards, and acute; the noſtrils are ſmall and linear; there is no tongue; and the feet have four toes. There are two ſpecies: 1. The Americana, or American jabiru, is about the ſize of a turky. The bill is long, ſtout, and of a black colour: the whole plumage is white, except the head, and about two-thirds of the neck, which are bare of feathers and of a blackiſh colour; the remainder is alſo bare, and of a fine red; on the hind-head are a few greyiſh feathers; the legs are ſtrong, of a great length, and covered with black ſcales; wings and tail even at the end. This bird is found in all the ſavannas of Cayenne, Guiana, and other parts of South America. It is migratory and gregarious. It makes its neſt in great trees, which grow on the borders; lays two eggs, and brings up the young in the neſt till they can deſcend to the ground. The colour of the young birds is grey; the ſecond year it changes to roſe-colour, and the third to pure white. They are very wild and voracious, and their food is fiſh, which they devour in great quantities. The fleſh of the young birds is ſaid to be good eating, but that of the old is hard and oily.

Mygdonia || Myagius.

2. The Aſiatica, or Indian jabiru, is of a large ſize. The bill is duſky, almoſt ſtraight above, and gibbous near the fore-head; the under mandible ſwelled beneath; and from the baſe of the bill there paſſes through and beyond the eye a black ſtreak. The general colour of the plumage is white; the lower half of the back, the prime quills, and the tail, are black; the legs a pale red. This ſpecies inhabits the Eaſt Indies, and feeds on ſnails.

MYGDONIA (anc. geog.), a diſtrict of Macedonia, to the north of the Sinus Thermaicus, and eaſt of the river Axius, which ſeparates it from Bottiæis, and weſt of the river Strymon, (Pliny.) Alſo a diſtrict of Meſopotamia, which took its name from that of Macedonia, running along the Euphrates, from Zeugma down to Thapſacus, extending a great way eaſt, becauſe Niſibis was reckoned to it.

MYGINDA, in botany: A genus of the tetragynia order, belonging to the tetrandria claſs of plants; and in the natural method ranking with thoſe of which the order is doubtful. The calyx is quadripartite; the petals four; the fruit a globoſe plum.

MYIAGRUS Deus, in the heathen mythology, a name given ſometimes to Jupiter, and ſometimes to Hercules, on occaſion of their being ſacrificed to for the driving away the vaſt numbers of flies which infeſted the ſacrifices on certain public occaſions. The word is uſually ſpelt *Myagrus*; but this muſt be an error, as this word does not expreſs the *fly-deſtroyer*, but the *mouſe-deſtroyer*; and we have it ſufficiently teſtified by the ancients, that flies were the only creatures againſt whom this deity was invoked. Pliny calls this deity alſo *Myiodes*, and tells us, that the flies which uſed to peſter the Olympic rites went away in whole clouds on the ſacrificing a bull to this god. We find in Athenæus alſo, that this ſacrificing to the god of flies at the Olympic games was a conſtant cuſtom. Some diſtinguiſh theſe two deities, and tell us that the latter, or Myiodes, uſed to viſit the nations in vengeance, with a vaſt multitude of flies; and that, on paying him the due honours of a ſacrifice, they all went away again; and this ſeems to agree with what Pliny tells us in ſome places.

At the time of the Olympic games, Jupiter was worſhipped under the name of the *Apomyos* or *Myiagrus Deus*, to ſupplicate the deſtruction of thoſe troubleſome creatures. This happened only once in many years, when the ſacrifices were performed there; but the Elians worſhipped him continually under this name, to deprecate the vengeance of heaven, which uſually ſent, as they expreſſed it, an army of flies and other inſects,

Myiodes || Mylaſa.

toward the latter end of the ſummer, that infeſted the whole country with ſickneſs and peſtilence.

MYIODES DEUS, in the heathen mythology, a name ſometimes given to Hercules, but more frequently to Jupiter, to whom a bull was ſacrificed, in order to make him propitious in driving away the flies that infeſted the Olympic games.

MYLAE (anc. geog.) a Greek city ſituated on an iſthmus of a cognominal peninſula, on the north eaſt ſide of the iſland. *Mylaei*, or *Mylenſes*, the people. A town built by thoſe of Zancle (Strabo.) Mylaeus, the epithet, as Mylæus Campus, mentioned by Polybius. Now called *Milazzo*, a port town of Sicily, in the Val di Demona. E. Long. 15° 5′. lat. 38. 36.

MYLASA, or MYLASSA, (anc. geog.), a noble city of Caria in Aſia Minor, ſituated at the diſtance of about three leagues from the *Sinus Ceramicus*. It was the capital of Hecatomnus king of Caria, and father of Mauſolus. Pliny ſpeaks of Menander king of Caria, and ſays that the Rhodians preſerved with the greateſt care his portrait painted by Apelles: but it was not in honour of this Menander that a Corinthian pillar was erected at Mylaſa, which ſtill exiſts, and on which is to be ſeen the following inſcription: "The people erected this pillar in honour of Menander, the ſon of Uliades, and grandſon of Euthydemus, the benefactor of his country, and whoſe anceſtors rendered it great ſervices alſo." Euthydemus, the grandfather of this Menander, lived in the time of Julius Cæſar and Auguſtus. Caria was taken by Mithridates, and afterwards by Labienus, whoſe father had been one of Cæſar's generals. Hybrias, whoſe eloquence and valour deſervedly intitled him to a diſtinguiſhed rank among his countrymen, in vain encouraged them to make a moſt obſtinate defence while it was beſieged by the latter. He himſelf was obliged to yield to neceſſity, and to take refuge at Rhodes: but ſcarcely had the conqueror quitted the city, when Hybrias returned, and reſtored liberty to his country. —Not content with rendering it this ſervice, he alſo deſtroyed the power of a dangerous citizen, whoſe riches and talents rendered him a neceſſary evil. Euthydemus, often baniſhed, and as often recalled, always too powerful in a ſtate the independence of which he threatened, ſaw his ambition checked by the zeal and activity of Hybrias. The Romans left to Mylaſa that liberty of which it rendered itſelf ſo worthy, by the great efforts it made to preſerve it. Pliny calls it *Mylaſa libera*. Strabo informs us, that it was one of the moſt magnificent cities of antiquity, and one of thoſe the temples, porticoes, and other public monuments of which were highly admired. A quarry of white marble in the neighbourhood furniſhed it with abundance of materials for erecting theſe edifices.—The Mylaſians had two temples dedicated to Jupiter, one ſituated in the city, which was named *Oſogo*, and another built on a mountain, at the diſtance of 60 leagues. The latter was dedicated to *Jupiter Stratius*, Jupiter the Warrior. His ſtatue, which was very ancient; inſpired great veneration; people came from all quarters to implore his protection; and for the greater accommodation of his votaries a paved way was conſtructed, which reached from Mylaſa to this venerable fabric. This city is now called *Melaſſo*, and, according to Dr. Chandler, is ſtill a large place.—The houſes are numerous, but chiefly of plaſter, and mean, with trees interſperſed. The air is accounted bad; and ſcorpions abound as anciently, entering often at the doors and windows, and lurking in the rooms. The plain is ſurrounded by lofty mountains, and cultivated. Round the town are ranges of broken columns, the remnants of porticoes, now with rubbiſh bounding the vineyards. A large portion of the plain is covered with ſcattered fragments, and with piers of ordinary aqueducts; beſides inſcriptions, moſtly ruined and illegible. Some altars dedicated to Hecatomnus have been diſcovered. Of all the ancient temples which formerly ornamented this city, one only eſcaped the power of time, the blind zeal of the early Chriſtians, and the barbarous ſuperſtition of the Mahometans. This monument was dedicated to Auguſtus and the divinity of Rome. When Pococke viſited Melaſſo, it was perfect and entire; but at preſent no traces of it remain, except a few fragments, which have been employed to conſtruct a Turkiſh moſque.

Mylogloſſum || Myoſotis.

MYLOGLOSSUM, in anatomy. See ANATOMY, *Table of the Muſcles*.

MYLOHYOIDÆUS. *Ibid.*

MYNSICHT (Hadrian), phyſician to the duke of Mecklenburgh and ſeveral other German princes, was diſtinguiſhed for his knowledge of chemiſtry, at the beginning of the 17th century. He publiſhed a work entitled *Armentarium Medico-Chymicum*, which has undergone various editions. In this work he gives a deſcription of ſeveral medicines, about the virtues of which he is not always to be depended upon. To him we are indebted for a knowledge of the ſalt *de duobus* or the *Arcanum*, which is ſtill in uſe.

MYOLOGY, (formed of μυς, μυος, "a muſcle," and λογος, "diſcourſe"), in anatomy, a deſcription of the muſcles; or the knowledge of what relates to the muſcles of the human body. See ANATOMY, *Table of the Muſcles*.

MYOMANCY, a kind of divination, or method of foretelling future events by means of mice.

Some authors hold myomancy to be one of the moſt ancient kinds of divination; and think it is on this account that Iſaiah, lxvi. 17. reckons mice among the abominable things of the idolators. But, beſide that it is not cereain that the Hebrew word עכבר uſed by the prophet ſignifies *a mouſe*, it is evident it is not the divination by that animal, be it what it will, that is ſpoken of, but the eating it.

MYOPIA, SHORT-SIGHTEDNESS; a ſpecies of viſion wherein objects are ſeen only at ſmall diſtances. See MEDICINE, n° 361.

MYOSOTIS, SCORPION-GRASS: A genus of the monogynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 41ſt order, *Aſperifoliæ*. The corolla is ſalver-ſhaped, quinquefid, and emarginated; the throat ſhut up by ſmall arches. There are four ſpecies; of which the moſt remarkable is the ſcorpioides, or mouſe-ear. This is a native of Britain, growing naturally in dry fields, and on the margins of ſprings and rills. It hath naked ſeeds, and the points of the leaves callous. It varies conſiderably in different ſituations. In dry places the plant and flowers are ſmaller; in moiſt ones both are larger, and ſometimes hairy. The bloſſoms

Myoſurus, Myoxus.

vary from a full blue to a very pale one, and ſometimes a yellow; and appear in a long ſpirally twiſted ſpike. When it grows in the water, and its taſte and ſmell is thereby rendered leſs obſervable, ſheep will ſometimes eat it; but it is generally fatal to them. Cows, horſes, ſwine, and goats refuſe it.

MYOSURUS, in botany: A genus of the polygynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 26th order *Multiſiliquæ*. The calyx is pentaphyllous, the leaves cohering at the baſe; there are five ſubulated nectaria reſembling petals: the ſeeds are numerous.

Plate CCCXVIII fig. 12.

MYOXUS, the DORMOUSE, in zoology; a genus of quadrupeds belonging to the order of glires. There are two fore-teeth in each jaw; the upper ones cuneated, the under compreſſed: the whiſkers are long; the tail is hairy and round, growing thicker towards the extremity; the fore and hind legs are of equal length, and the fore-feet have four toes.

1. The glis, or hoary dormouſe, is of a pale aſh-colour on the upper parts of the body, and whitiſh on the under; and is about the ſize of the common ſquirrel, but thicker in the body. It inhabits France and the ſouth of Europe, and the ſouth-weſt of Ruſſia about the Volga of Samara. This animal, which is the ἔλειος of Ariſtotle, μυοξος of Oppian, and *glis* of Pliny, was held in great eſteem among the Romans, as a luxurious delicacy; they were fed in places called *gliriaria*, conſtructed for the purpoſe, and they are ſtill eaten by the modern Italians. It forms a neſt in the hollow of ſome tree, in which it ſleeps all day; feeds in the night on nuts, walnuts, the ſeeds of apples, &c. and grows very fat in autumn. About the month of October they gather in troops; and, retiring into ſubterranean burrows, remain torpid till near the end of May. The female has ten teats, ſix of which are ſituated on the breaſt, and four on the belly; and ſhe brings from nine to twelve young ones at a litter.

Fig. 14.

2. The nitella, or garden dormouſe, is of a tawny colour on the upper parts of the body, and whitiſh aſh-tinged with yellow on the under; has a black circle round each eye, and a black ſpot behind each ear; and is five inches long, beſides the tail which meaſures four. It inhabits the ſouth parts of Europe and Ruſſia, where it lives chiefly in gardens, though it ſometimes is found in houſes. They are very deſtructive to fruit, particularly peaches, which they ſeem to prefer to every other kind. They alſo eat peaſe, apricots, and plums; and when ſoft fruits are not to be had, they will eat almonds, filberts, nuts, and even leguminous plants. Of theſe they carry off great quantities into their retreats, which they dig in the earth, and particularly in well cultivated gardens; for in old orchards they are often found in hollow trees, where they make beds of herbs, moſs, and leaves. Eight or ten of them are frequently found in the ſame place, all benumbed, and rolled up in the midſt of their proviſion of fruits and nuts. They copulate in ſpring, and bring forth in ſummer. The litter conſiſts of five or ſix young, who grow very quickly, but are not fertile till the next year. Their fleſh is not eatable, but has the ſame diſagreeable odour with the domeſtic rat.

Fig. 3.

3. The muſcardinus, or common dormouſe, is about the ſize of the domeſtic mouſe, but of a plumper appearance; the noſe is more blunt; the head, ſides, belly, and tail, are of a tawny red colour, the throat white. Dormice inhabit woods, or very thick hedges; forming their neſts in the hollow of ſome low tree, or near the bottom of a cloſe ſhrub: they form little magazines of nuts, and eat in an upright poſture like the ſquirrel. The conſumption of their hoard, however, during the rigour of the ſeaſon is but ſmall; for they ſleep moſt of the time, retiring into their holes; at the approach of winter they roll themſelves up, and become torpid. Sometimes they experience a ſhort revival in a warm ſunny day, when they take a little food, and relapſe into their former ſtate. Theſe animals ſeldom appear far from their retreats, or in any open place; for which reaſon they ſeem leſs common in Britain than they rea ly are. They make their neſts of moſs, graſs, and dead leaves; and bring uſually three or four young at a time.

Myrepſus ‖ Myrica.

MYREPSUS (Nicolas), was a phyſician of Alexandria, to whom we are under great obligations for the pains he took to collect, into a kind of pharmacopœia, all the compound medicines which lie ſcattered in the works of the Greeks and Arabian writers. his work was accompliſhed before the beginning of the 14th century; and though written in barbarous Greek, continued for a long time to be the rule of pharmaceutical preparations in Europe. A tranſlation of it into Latin by Leonard Fuſch is entitled *Opus Medicamentorum, in Sectiones quadraginta octo digeſtum*. There are a great many editions of this work: the beſt is that of Hartman Beverus, Nuremberg, 1658, 8vo.

MYRIAD, a term ſometimes uſed to denote ten thouſand.

MYRICA, GALE, or SWEET-WILLOW, in botany: A genus of the tetrandria order, belonging to the dicœcia claſs of plants; and in the natural method ranking under the 5th order, *Amentaceæ*. The ſcale of the male catkin is in the form of a creſcent, without any corolla. The ſcale of the female catkin the ſame: there is no corolla; but two ſtyles, and a monoſpermous berry.

1. The gale, Dutch myrtle, or ſweet-willow, grows naturally upon bogs in many places both of Scotland and England. It riſes about four feet high, with many ſhrubby ſtalks, which divide into ſeveral ſlender branches, garniſhed with ſtiff ſpear-ſhaped leaves of a light yellowiſh green, ſmooth, and a little ſawed at their points. The female flowers or catkins are produced from the ſides of the branches, growing upon ſeparate plants from the female, which are ſucceeded by cluſters of ſmall berries, each having a ſingle ſeed. It flowers in July, and ripens in autumn. When tranſplanted into ſhrubberies, the moiſteſt parts muſt be aſſigned to it.

The leaves, flowers, and ſeeds, of this plant, have a ſtrong fragrant ſmell, and a bitter taſte. They are ſaid to be uſed among the common people for deſtroying moths and cutaneous inſects, being accounted an enemy to inſects of every kind; internally, in infuſions, as a ſtomachic and vermifuge; and as a ſubſtitute to hops for preſerving malt liquors, which they render more inebriating, and of conſequence leſs ſalubrious: it is ſaid that this quality is deſtroyed by boiling.

The

Myrica. 2. The cerifera, wax-bearing myrica, or candleberry myrtle, is a native of North America. It is a ſmall tree about ten or twelve feet high, with crooked ſtems branching forth near the ground irregularly. The leaves grow irregularly on them all round; ſometimes by pairs, ſometimes alternately, but generally at unequal diſtances. They are of a lanceolated figure; and ſome are ſerrated at the top, whilſt others have their edges wholly entire. They ſtand on very ſhort footſtalks; having their upper ſurface ſmooth, and of a ſhining green colour, whilſt their under is of a more duſky hue. The branches of the old plants ſhed their leaves in the autumn; but the young plants raiſed from ſeeds retain them the greateſt part of the winter, ſo as during that ſeaſon to have the appearance of an evergreen. But this beauty will not be laſting, for they ſhed their leaves proportionally earlier as the plants get older. There are both male and female trees of this ſort: The flowers are ſmall, of a whitiſh colour, and make no figure; neither does the fruit that ſucceeds the female, which is a ſmall, dry, blue berry, though produced in cluſters, make any ſhow: So that it is from the leaves this trees receives its beauty and value; for theſe being bruiſed, as well as the bark of the young ſhoots, emit the moſt refreſhing and delightful fragrance, that is exceeded by no myrtle, or any other aromatic ſhrub.

There is a variety of this ſpecies of lower growth, with ſhorter but broader leaves, and of equal fragrance. This grows commonly in Carolina; where the inhabitants collect from its berries a wax of which they make candles, and which occaſions its being called the *candleberry tree*. It delights in a moiſtiſh ſoil. —The wax is procured in the following manner: In November and December, when the berries are ripe, a man with his family will remove from home to ſome iſland or ſand-bank near the ſea, where theſe trees moſt abound, taking with them kettles to boil the berries in. He builds a hut with palmetto leaves for the ſhelter of himſelf and family during his reſidence there, which is commonly four or five weeks. The man cuts down the trees, while the children ſtrip off the berries into a porridge-pot; and having put water to them, they boil them till the oil floats, which is then ſkimmed off into another veſſel. This is repeated till no more oil appears. When cold, this hardens to the conſiſtence of wax, and is of a dirty green colour. Then they boil it again, and clarify it in braſs kettles; which gives it a tranſparent greenneſs. Theſe candles burn a long time, and yield a grateful ſmell. They uſually add a fourth part of tallow, which makes them burn clearer. Both the above ſorts may be propagated by ſeeds or layers. 1. The ſeeds of the candleberry myrtle we receive from abroad; thoſe of the ſweet-gale from the bogs, where they grow in England or Scotland. The beſt way is to ſow them in boxes of earth from a rich paſture, well broken and fine. They ſhould be ſown about half an inch deep; and when the hot weather comes on, ſhould be ſet in the ſhade. They will often remain until the ſecond year before they come up, eſpecially thoſe ſeeds that come from abroad. If the boxes are ſet in the ſhade, and the plants come up, they will require no other trouble the firſt ſummer than keeping clean from weeds; in winter they ſhould be removed to a warm hedge or wall, where they may enjoy the benefit of the ſun. In the following ſpring they will come up in plenty. In the beginning of May they ſhould reſume their ſhady ſituation; and this ſummer they will require no other trouble than weeding and watering in dry weather. In the winter they ſhould be removed into a well-ſheltered place; and this may be repeated two years; when in the ſpring they ſhould be taken out of the boxes, and planted in the nurſery at about a foot aſunder. 2. Theſe ſorts may be alſo eaſily propagated by layers; for this operation being performed on the young wood in the autumn, will occaſion them to ſhoot good roots by the autumn following; many of which will be good plants, fit for any place. 3. Theſe plants may likewiſe be increaſed by ſuckers, for many of them often throw them out in vaſt plenty; ſo that theſe being taken out, the ſtrongeſt and beſt-rooted may be finally ſet out; whilſt the weaker, and thoſe with leſs root, may be planted in the nurſery.

Myrica Myriſtica.

There are five other ſpecies, *viz.* the *nagi*, or Japan myrica, with lanceolate entire veinleſs leaves, and berries about the ſize of a cherry: the *ethiopica*, or willow-leaved myrica, with the leaves ſlightly ſerrated; a native of Ethiopia: the *quercifolia*, with oblong leaves, ſinuated or notched on the ſides, like the leaves of the oak; of which there are two varieties, the ſmooth and the hairy, natives of the Cape of Good Hope: the trifoliata, or trifoliate myrica, with ternate leaves toothed on the edges; and the cordifolia, or heart-leaved myrica, with ſubcordated, ſawed, ſeſſile leaves; both alſo natives of the Cape. Theſe are all tender plants, kept as curioſities in the greenhouſe, and difficult of propagation.

MYRIOPHYLLUM, in botany: A genus of the polyandria order, belonging to the monœcia claſs of plants; and in the natural method ranking under the 15th order, *Inundatæ*. The male calyx is tetraphyllous; there is no corolla; the ſtamina are eight in number. The female calyx is tetraphyllous; the piſtils four; there is no ſtyle; and four naked ſeeds.

MYRISTICA, the NUTMEG-TREE, in botany: A genus of plants belonging to the claſs dicœcia, and order ſyngeneſia, in the *New Genera Plantarum* of Linnæus by *Shreber*; and of the natural order *Lauri*, in his fourth claſs *Monocotylidones*.—The male calyx is monophyllous, ſtrong, and parted into three *lacinii* of an oval ſhape, and ending in a point: it has no corolla. In the middle of the receptacle riſes a column of the height of the calyx; to the upper part of which the antheræ are attached. They vary in number from three to twelve or thirteen.—The female calyx and corolla as in the male, on a diſtinct tree. The germen of an oval ſhape; the ſtyle ſhort, with a bifid ſtigma; the lacinii of which are oval and ſpreading.—The fruit is of that ſort called *drupa*. It is fleſhy, roundiſh, ſometimes unilocular, ſometimes bivalved, and burſts when ripe at the ſide. The ſeed is enveloped with a fleſhy and fatty membraneous ſubſtance, which divides into filaments (this, in one of the ſpecies, is the mace of the ſhops). The ſeed or nutmeg is round or oval ſhaped, unilocular, and contains a ſmall kernel, variegated on the ſurface by the fibres running in the form of a ſcrew.

Species. There are five ſpecies of this genus according

Myriſtica. cording to ſome authors; but ſeveral of theſe being only varieties, may be reduced to three, viz.

1. Myriſtica fatua, or wild nutmeg: this grows in Tobago, and riſes to the height of an apple-tree; has oblong, lanceolated, downy leaves, and hairy fruit:—the nutmeg of which is aromatic, but when given inwardly is narcotic, and occaſions drunkenneſs, delirium, and madneſs, for a time. See a figure in *Gaertner de Sem* and *Fruct.* T. 41. f. 3. 4.

2. The myriſtica ſebifera, (*Virola Sibifera Aublet*, page 904. Tab. 345.) A tree frequent in Guiana, riſing to 40 or even to 60 feet high; on wounding the trunk of which, a thick, acrid, red juice runs out. Aublet ſays nothing of the nutmegs being aromatic; he only obſerves, that a yellow fat is obtained from them, which ſerves many œconomical and medical purpoſes, and that the natives make candles of it.

3. The myriſtica moſchata, or nutmeg, attains the height of 30 feet, producing numerous branches which riſe together in ſtories, and covered with bark, which of the trunk is a reddiſh brown, but that of the young branches is of a bright green colour: the leaves are nearly elliptical, pointed, undulated, obliquely nerved, on the upper ſide of a bright green, on the under whitiſh, and ſtand alternately upon footſtalks: the flowers are ſmall, and hang upon ſlender peduncles, proceeding from the axillæ of the leaves: they are both male and female upon ſeparate trees.

M. Schwartz, who has carefully examined this as well as the two firſt ſpecies, preſerved in ſpirits, places them amongſt the monodelphia.

The nutmeg has been ſuppoſed to be the *Comacum* of Theophraſtus, but there ſeems little foundation for this opinion; nor can it with more probability be thought to be the *Chryſobalanos* of Galen. Our firſt knowledge of it was evidently derived from the Arabians; by Avicenna it was called *jiauſiban*, or *jauſiband*, which ſignifies nut of banda. Rumphius both figured and deſcribed this tree; but the figure given by him is ſo imperfect, and the deſcription ſo confuſed, that Linnæus, who gave it the generic name *myriſtica*, was unable to aſſign its proper characters.—Sonnerat's account of the *muſcadier* is ſtill more erroneous; and the younger Linnæus was unfortunately miſled by this author, placing the myriſtica in the claſs *Polyandria*, and deſcribing the corolla as conſiſting of five petals. Thunberg, who examined the flower of the nutmeg, places it in the claſs *Monoecia*; and according to his deſcription, the male flower has but one filament, ſurrounded at the upper part by the antheræ; and as the filaments are ſhort and ſlender, and the antheræ united, this miſtake might eaſily ariſe. M. De La Marck informs us, that he received ſeveral branches of the myriſtica, both in flower and fruit, from the Iſle of France, where a nutmeg-tree, which was introduced by Monſieur Poivre in 1770, is now very large, and continually producing flowers and fruit. From theſe branches, which were ſent from Monſ. Cere, director of the king's garden in that iſland, Monſ. De La Marck has been enabled to deſcribe and figure this and other ſpecies of the myriſtica with tolerable accuracy: and that we have profited by his labours, will appear from the annexed plate, of which the following is an explanation:

Plate CCCXXXIV. Fig. *a*. A ſprig with fructification. The drupa of the natural ſize, and burſting open. Fig. *b*. The full-grown fruit cut lengthways. Fig. *c*. Another ſection of the ſame. Fig. *d*. The nutmeg enveloped with its covering the mace. Fig. *e*. The fatty membrane or mace ſpread out. Fig. *f*. The nutmeg of its natural ſize. Fig. *g*. The ſame with its external tegument removed at one end. Fig. *h*. The ſame with its outer tegument entirely removed. Fig. *i*. A tranſverſe ſection of the nutmeg. Fig. 1. and 2. Sprigs of the *Myriſtica moſchata* in flower, with a leaf of the natural ſize, and a repreſentation of the calyx and column in the flower. Myriſtica. Plate CCCXXXV.

The ſeeds or kernels called *nutmegs* are well known, as they have been long uſed both for culinary and medical purpoſes. Diſtilled with water, they yield a large quantity of eſſential oil, reſembling in flavour the ſpice itſelf; after the diſtillation, an inſipid ſebacious matter is found ſwimming on the water; the decoction inſpiſſated, gives an extract of an unctous, very lightly bitteriſh taſte, and with little or no aſtringency. Rectified ſpirit extracts the whole virtue of nutmegs by infuſion, and elevates very little of it in diſtillation; hence the ſpirituous extract poſſeſſes the flavour of the ſpice in an eminent degree.

Nutmegs, when heated, yield to the preſs a conſiderable quantity of limpid yellow oil, which on cooling concretes into a ſebaceous conſiſtence. In the ſhops we meet with three ſorts of unctuous ſubſtances, called *oil of mace*, though really expreſſed from the nutmeg. The beſt is brought from the Eaſt Indies in ſtone jars; this is of a thick conſiſtence, of the colour of mace, and has an agreeable fragrant ſmell; the ſecond ſort, which is paler coloured, and much inferior in quality, comes from Holland in ſolid maſſes, generally flat, and of a ſquare figure: the third, which is the worſt of all, and uſually called *common oil of mace*, is an artificial compoſition of ſevum, palm oil, and the like, flavoured with a little genuine oil of nutmeg.

Method of gathering and preparing Nutmeg. When the fruit is ripe, the natives aſcend the trees, and gather it by pulling the branches to them with long hooks. Some are employed in opening them immediately, and in taking off the green ſhell or firſt-rhind, which is laid together in a heap in the woods, where in time it putrefies. As ſoon as the putrefaction has taken place, there ſpring up a kind of muſhrooms, called *boleti moſchatyni*, of a blackiſh colour, and much valued by the natives, who conſider them as delicate eating. When the nuts are ſtripped of their firſt rhind they are carried home, and the mace is carefully taken off with a ſmall knife. The mace, which is of a beautiful red, but afterwards aſſumes a darkiſh or reddiſh colour, is laid to dry in the ſun for the ſpace of a day, and is then removed to a place leſs expoſed to his rays, where it remains for eight days, that it may ſoften a little. They afterwards moiſten it with ſea-water, to prevent it from drying too much, or from loſing its oil. They are careful, however, not to employ too much water, leſt it ſhould become putrid, and be devoured by the worms. It is laſt of all put into ſmall bags, and ſqueezed very cloſe. Mace muſt not be confounded with *macer*. See the word Macer.

The nuts, which are ſtill covered with their ligneous ſhell, are for three days expoſed to the ſun, and afterwards

Myriſtica

afterwards dried before a fire till they emit a ſound when they are ſhaken; they then beat them with ſmall ſticks in order to remove their ſhell, which flies off in pieces. Theſe nuts are diſtributed into three parcels; the firſt of which contains the largeſt and moſt beautiful, which are deſtined to be brought to Europe; the ſecond contains ſuch as are reſerved for the uſe of the inhabitants; and the third contains the ſmalleſt, which are irregular or unripe. Theſe are burnt; and part of the reſt is employed for procuring oil by preſſure. A pound of them commonly gives three ounces of oil, which has the conſiſtence of tallow, and has entirely the taſte of nutmeg. Both the nut and mace, when diſtilled, afford an eſſential, tranſparent, and volatile oil, of an excellent flavour.

The nutmegs which have been thus ſelected would ſoon corrupt if they were not watered, or rather pickled, with lime-water made from calcined ſhell-fiſh, which they dilute with ſalt-water till it attain the conſiſtence of fluid pap. Into this mixture they plunge the nutmegs, contained in ſmall baſkets, two or three times, till they are completely covered over with the liquor. They are afterwards laid in a heap, where they heat, and loſe their ſuperfluous moiſture by evaporation. When they have ſweated ſufficiently, they are then properly prepared, and fit for a ſea-voyage.

In the iſland of Banda, the fruit of the nutmeg-tree is preſerved entire in the following manner: When it is almoſt ripe, but previous to its opening, it is boiled in water and pierced with a needle. They next lay it in water to ſoak for ten days, till it has loſt its ſour and ſharp taſte. They then boil it gently in a ſyrup of ſugar, to which, if they wiſh it to be hard, a little lime is added. This operation is repeated for eight days, and each time the ſyrup is renewed. The fruit when thus preſerved is put for the laſt time into a pretty thick ſyrup, and is kept in earthen pots cloſely ſhut.

Theſe nuts are likewiſe pickled with brine or with vinegar; and when they intend to eat them, they firſt ſteep them in freſh water, and afterwards boil them in ſyrup of ſugar, &c.

Uſes. Nutmegs preſerved entire are preſented as deſerts, and the inhabitants of India ſometimes eat them when they drink tea. Some of them uſe nothing but the pulp; others likewiſe chew the mace; but they generally throw away the kernel, which is really the nutmeg. Many who perform ſea-voyages to the north chew this fruit every morning.

The medicinal qualities of nutmeg are ſuppoſed to be aromatic, anodyne, ſtomachic, and reſtringent; and with a view to the laſt mentioned effects, it has been much uſed in diarrhœas and dyſenteries. To many people the aromatic flavour of nutmeg is very agreeable; they however ſhould be cautious not to uſe it in large quantities, as it is apt to affect the head, and even to manifeſt an hypnotic power in ſuch a degree as to prove extremely dangerous. Bontius ſpeaks of this as a frequent occurrence in India; and Dr Cullen relates a remarkable inſtance of this ſoporific effect of the nutmeg, which fell under his own obſervation, and hence concludes, that in apoplectic and paralytic caſes this ſpice may be very improper. He obſerves, that a perſon by miſtake took two drams or a little more of powered nutmeg: he felt it warm in his ſtomach, without any uneaſineſs; but in about an hour after he had taken it he was ſeized with a drowſineſs, which gradually increaſed to a complete ſtupor and inſenſibility; and not long after he was found fallen from his chair, lying on the floor of his chamber in the ſtate mentioned. Being laid a-bed he fell aſleep; but waking a little from time to time, he was quite delirious; and he thus continued alternately ſleeping and delirious for ſeveral hours. By degrees, however, both theſe ſymptoms diminiſhed; ſo that in about ſix hours from the time of taking the nutmeg he was pretty well recovered from both. Although he ſtill complained of head-ach, and ſome drowſineſs, he ſlept naturally and quietly the following night, and next day was quite in his ordinary health. Myriſtica.

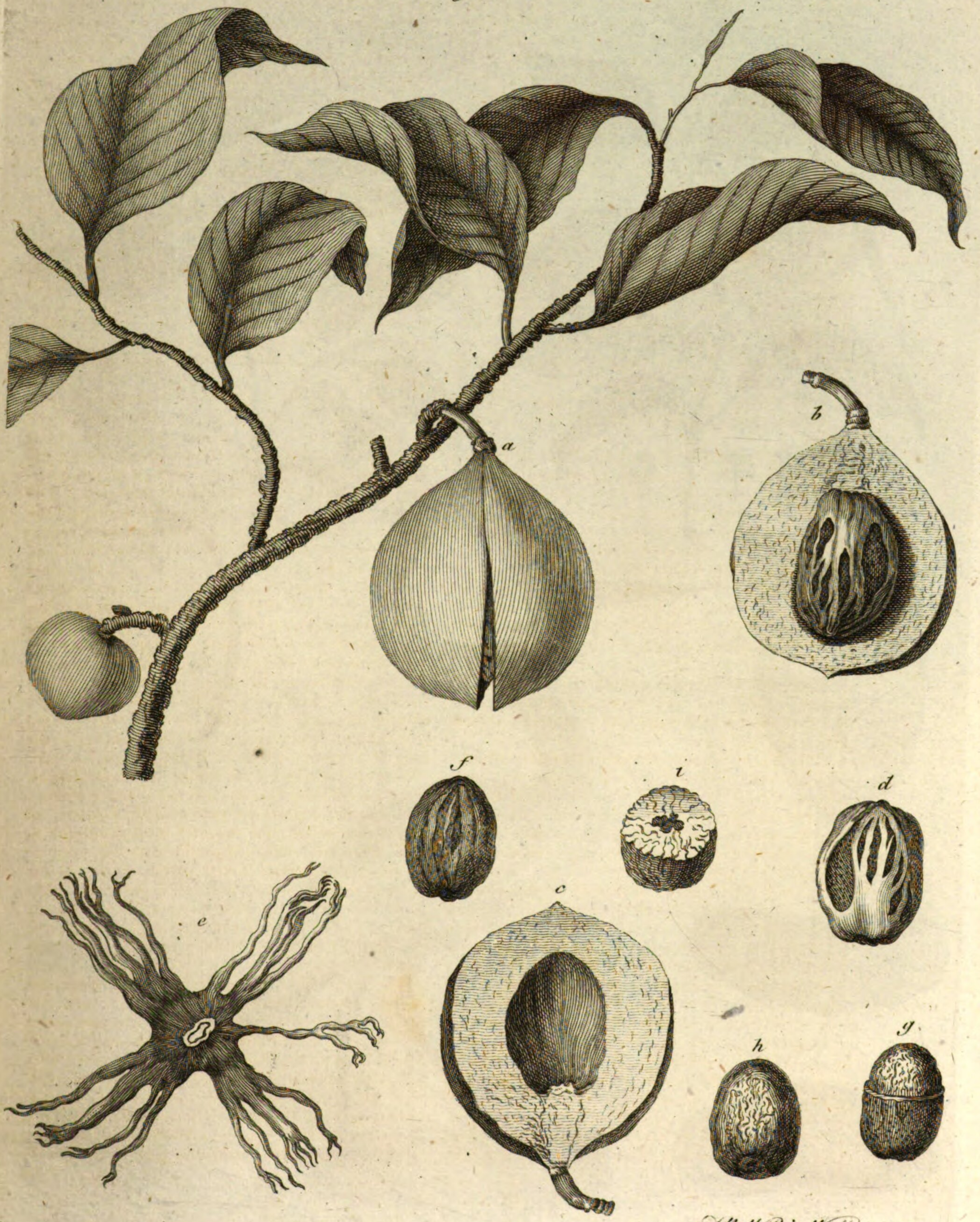
The officinal preparations of nutmeg are a ſpirit and eſſential oil, and the nutmeg in ſubſtance roaſted, to render it more aſtringent. Both the ſpice itſelf and its eſſential oil enter ſeveral compoſitions, as the confectio aromatica, ſpiritus amoniæ com. &c. Mace poſſeſſes qualities ſimilar to thoſe of the nutmeg, but is leſs aſtringent, and its oil is ſuppoſed to be more volatile and acrid.

Remarks on the Trade of Nutmegs. Nutmeg-trees grow in ſeveral iſlands in the eaſtern ocean. The wood-pigeon of the Moluccas is unintentionally a great planter of theſe trees, and diſſeminates them in places where a nation, powerful by its commerce, thinks it for its intereſt that they ſhould be rooted out and deſtroyed. The Dutch, whoſe unwearied patience can ſurmount the greateſt obſtacles, have appropriated to themſelves the crop of nutmeg, as well as that of cloves and cinnamon, growing in the iſlands of Ternate, Ceylon, &c. either by right of conqueſt or by paying ſubſidies to the iſlanders, who find theſe much more profitable than the former produce of their trees. It is nevertheleſs true, that they have prevailed upon or compelled the inhabitants of the Moluccas to cut down and root out all the clove-trees, which they have preſerved only in the iſlands of Amboina and Ternate, which are in a great meaſure ſubject to them. We know for certain, that the Dutch pay 18,000 rixdollars yearly to the king of Ternate, by way of tribute or gift, in order to recompence him for the loſs of his clove-trees in the other Molucca iſlands; and that they are moreover bound by treaty to take at 3¼d. a pound, all the cloves brought by the natives of Amboyna to their magazines. They have likewiſe ſucceeded to deſtroy the cinnamon every where except in the iſland of Ceylon, which is in their poſſeſſion. The ſame is the caſe with white pepper, &c. ſo that the trade of the whole of Europe, and of great part of Aſia in this ſpecies of commodity, paſſes through their hands.

The Dutch have immenſe and very rich magazines of theſe precious aromatics, both in India and Europe. They have actually by them the produce of 16 years, and never ſupply their neighbours with the laſt, but always with the oldeſt crop: in 1760 they ſold what was laid up in 1744. It is commonly ſaid, that when the Dutch have too great a quantity of cloves, nutmeg, &c. in their magazines, they throw them into the ſea; but the fact is, that they get rid of their ſuperfluous aromatics by burning them. On the

Myristica.

Plate CCCXXXIV.



A.B. del. Prin. Wall, Sculpsit Soc.

Myristica.

Fig. 1.

Fig. 2.

Myctéria Américana.

Mya.

1

2

3

4

A. Bell Prin. Wal. Sculptor fecit.

Myrmecophaga.

the 10th of June 1760, M. Beaumare ſaw at Amſterdam, near the Admiralty, a fire, the fuel of which was valued at 8,000,000 of livres; and as much was to be burned on the day following. The feet of the ſpectators were bathed in the eſſential oil of theſe ſubſtances; but no perſon was allowed to gather any of it, much leſs to take any of the ſpices which were in the fire. Some years before, upon a ſimilar occaſion, and at the ſame place, a poor man who had taken up ſome nutmegs which had rolled out of the fire, was, as M. Beaumare was informed, ſeized and condemned to immediate execution. We will only add, that notwithſtanding the jealouſy of the Dutch, and the pains they take to preſerve the ſale of cloves wholly to themſelves, they have never been able to prevent their own officers in ſeveral parts of India from embezzling and ſelling conſiderable quantities of them. M. de Jaucourt informs us, that in order to defraud the company, they ſell them to the veſſels of other nations which they meet at ſea, and moiſten the remainder with water, that they may ſtill have the number of quintals of which their cargo conſiſted. The quantity ſold may amount to 10 quintals in 100 before it can be perceived by the clerks of the magazines at Batavia, where they are received.

We are informed by M. Romé de Liſle, who has lately arrived from India, that the Engliſh draw a great deal of cinnamon, pepper, and cloves, from the iſland of Sumatra. The ſtaple for this commodity, which gives great offence to the Dutch, is at the factory of Bencoolen. We have likewiſe ſeen a ſpecimen of pretty good cinnamon raiſed at Martinico — The French, to prevent the exportation of ſpecie for theſe aromatic and exotic productions, have attempted to introduce the culture of them into ſome of their colonies. A great many plants of the clove and nutmeg-tree have been procured, and planted in the Iſle of France, the iſland of Bourbon, and alſo at Cayenne, where they have a very promiſing appearance.

Plate cccxxvi.

MYRMECOPHAGA, or ANT-BEAR, in zoology; a genus of quadrupeds, belonging to the order of bruta: There are no teeth in the mouth; the tongue is long and cylindrical; the head terminates in a long ſnout or muzzle; and the body is covered with pretty long hair. There are five ſpecies, viz.

1. The didactyla, or little ant-bear, hath a conic noſe bending a little down; ears ſmall, and hid in the fur; two hooked claws on the fore-feet, the exterior being much the largeſt; four on the hind-feet; the head, body, limbs, and upper part and ſides of the tail, covered with long ſoft ſilky hair, or rather wool, of a yellowiſh brown colour: from the noſe to the tail it meaſures ſeven inches and an half; the tail eight and an half, the laſt four inches of which on the under ſide are naked. It is thick at the baſe, and tapers to a point. It inhabits Guinea, climbs trees in queſt of a ſpecies of ants which build their neſts among the branches: has a prehenſible power with its tail.

2. The tridactyla, tamandua-guaca, or tamanoir, has three toes on the fore-feet, five on the hind-feet, and long hair on the tail. This animal is about four feet long, and the head and ſnout about 15 inches: it is a native of the Eaſt Indies, and feeds on ants, &c. in the ſame manner as the former.

3. The jubata, or great ant-bear, has a long ſlender noſe, ſmall black eyes; ſhort round ears; a ſlender tongue two feet and an half long, which lies double in the mouth; the legs ſlender; four toes on the fore-feet, five on the hind-feet; the two middle claws on the fore-feet very large, ſtrong, and hooked; the hair on the upper part of the body is half a foot long, black mixed with grey; the fore-legs are whitiſh, marked above the feet with a black ſpot; the tail is clothed with very coarſe black hair a foot long: the length from the noſe to the tail about four feet; the tail two feet and an half. This animal inhabits South America, and the kingdom of Congo in Africa. It covers itſelf with its tail when aſleep and to guard againſt rain. Its fleſh is eaten by the natives of America.

Myrmecophaga, Myrmelon.

4. The tetradactyla, or middle ant-bear, has four toes on the fore-feet, and five on the hind, with a tail naked at the extremity; the length from the noſe to the tail is one foot ſeven inches, and the tail ten inches. It inhabits South America.

5. The capenſis, or Cape ant-bear, has four claws on the fore-paws; a long ſnout; large pendent ears; and a tail, which is ſhorter than the body, and taper at the point. It inhabits the country at the Cape of Good Hope.—This animal is much larger than the other ſpecies of the genus, ſo that Kolben compares it to the ſize of a hog, and aſſerts that it weighs 100 pounds. It burrows in the ground, ſleeps during the day, and only goes abroad at night.

Theſe animals have many properties in common with each other, both in their ſtructure and manners. They all feed upon ants, and plunge their tongues into honey and other liquid or viſcid ſubſtances. They readily pick up crumbs of bread, or ſmall morſels of fleſh. They are eaſily tamed, and can ſubſiſt for a long time without food. They never ſwallow all the liquor which they take for drink; for a part of it falls back through their noſtrils. They run ſo ſlowly, that a man may eaſily overtake them in an open field.—Their fleſh, though its taſte be very diſagreeable, is eaten by the ſavages. At a diſtance the great ant-eater has the appearance of a fox; and for this reaſon ſome travellers have given him the name of the *American fox*. He has ſtrength ſufficient to defend himſelf from a large dog, or even from the jaquar or Braſilian cat. When attacked, he at firſt fights on end, and, like the bear, annoys his enemy with the claws of his fore-feet, which are very terrible weapons.—He then lies down on his back, and uſes all the four feet, in which ſituation he is almoſt invincible; and continues the combat to the laſt extremity. Even when he kills his enemy, he quits him not for a long time after. He is enabled to reſiſt better than moſt other animals, becauſe he is covered with long buſhy hair; his ſkin is remarkably thick; his fleſh has little ſenſation; and his principle of life is very tenacious.

MYRMELION, or ANT-LION, in zoology; a genus of inſects of the nemopteca order. There are 15 ſpecies, of which the moſt remarkable is the formicarius, or ant-eater. The perfect inſect is oblong, and of a brown colour. Its head is broad, with two large eyes on the ſides, and two antennæ beneath The neck is rather long, cylindrical, and narrower than the head. The thorax ſeems compoſed of two parts; one ante-

Myrmelion, Myrmidons.

rior, whence ariſe the upper wings; and the other poſterior, which gives birth to the under ones. The abdomen is of an oblong form, and conſiſts of eight ſegments; the wings are diaphanous, adorned with a net-work of black fibres, charged with ſeveral blackiſh brown ſpots The larva of this inſect is very fond of ants, which it hunts after, whence its name. The larvæ proceed from the egg which the perfect inſect had depoſited in very fine dry ſand, in a place ſheltered from rain, either within a cleft of a wall or of the ground, or at the foot of a wall generally expoſed to the ſouth ſun. There they are hatched, and make their uſual abode. Their colour is grey, and their body, which is covered with ſmall protuberances, is of an oval form. Its poſterior extremity terminates in a point, and is of uſe to ſink itſelf down into the ſand; for it only walks retrogreſſively, though furniſhed with ſix feet. Before the head is placed a dentated forceps, ſharp and hollow within, with which the creature catches and ſucks flies and other inſects, but eſpecially ants. This forceps ſerves as a mouth or roſtrum, as well as for an offenſive weapon. The animal's retrograde march not allowing it to run after the inſects on which it is to feed, it uſes a ſtratagem. It dives down into the ſand, and turning about in a circle, hollows out concentric furrows, gradually deeper and deeper, caſting at a diſtance with its horns the ſand it takes from that place. At length it manages to dig a hole in ſhape like a funnel, at the bottom of which it takes its ſtation, concealed in the ſand, nothing but the open extended forceps appearing above it. Miſchief overtakes every inſect that happens to fall into that hole. The myrmelio, who is apprized of it by the grains of ſand rolling down to the bottom, overwhelms him with a ſhower of duſt, which it ejects with its horns, then drags the inſect to the bottom of the hole, where it ſeizes him with its forceps, and ſucks its vitals. It does not even ſpare other myrmelions who in their motions to and fro chance to fall into it. When the larva is come to its full growth, it digs no more holes; it moves backwards and forwards, tracing irregular furrows on the ſand, and at length ſpins itſelf a cod, ſhaped like a ball, the outward part of which is formed of the ſand in which it lived, and the inward is lined with fine white ſilk. Within this cod it turns to a chryſalis, which is curved into a ſemicircle, and wherein may be diſtinguiſhed all the parts of the perfect inſect that is to iſſue from it. It is more oblong than the larva, but much ſhorter than the perfect inſect. After a certain period, the chryſalis caſts off its ſlough, turns to a winged inſect, and breaks through the cod in order to take its flight. The perfect inſect is very ſcarce, but is ſometimes met with in ſandy places, and near rivulets.

Barbut's Genera of Inſects, p 223.

MYRMIDONS (Myrmidones), in antiquity; a people on the ſouthern borders of Theſſaly, who accompanied Achilles to the Trojan war. They received their name from Myrmidon, a ſon of Jupiter and Eurymeduſa, who married one of the daughters of Æolus, ſon of Helen. His ſon Actor married Ægina the daughter of Aſopus. He gave his name to his ſubjects, who dwelt near the river Peneus in Theſſaly. According to ſome, the Myrmidons received their name from their having ariſen from ants or piſmires, upon a prayer put up for that purpoſe by king Æacus to Jupiter, after his kingdom had been diſpeopled by a ſevere peſtilence. According to Strabo, they received it from their induſtry, becauſe they imitated the diligence of the ants, and like them were indefatigable, and were continually employed in cultivating the earth.

Myrmillones || Myroxylon.

MYRMILLONES were gladiators of a certain kind at Rome, who fought againſt the Retiarii. Their arms were a ſword, head-piece, and ſhield. On the top of the head-piece they wore a fiſh emboſſed, called Μορμυρος, whence their name is by ſome ſuppoſed to be derived. The Retiarii, in their engagements, made uſe of a net, in which they endeavoured to entangle their adverſaries, and ſung during the fight, "*Non te peto, piſcem peto; quid me fugis, Galle?*" "I aim not at thee, but I aim at thy fiſh; why doſt thou ſhun me, O Gaul?" The Myrmillones were called Galli, becauſe they wore Gallic armour. They were alſo named *Secutores*. This kind of gladiators was ſuppreſſed by Caligula. See Gladiators, Retiari, &c.

MYROBALANS, a kind of medicinal fruit brought from the Indies, of which there are five kinds. 1. The citrine, of a yellowiſh red colour, hard, oblong, and the ſize of an olive. 2. The black, or Indian myrobalan, of the bigneſs of an acorn, wrinkled, and without a ſtone. 3. Chebulic myrobalans, which are of the ſize of a date, pointed at the end, and of a yellowiſh brown. 4. Emblic, which are round, rough, the ſize of a gall, and of a dark brown. 5. Balleric, which are hard, round, of the ſize of an ordinary prune, leſs angular than the reſt, and yellow. They are all ſlightly purgative and aſtringent. The word comes from the Greek μυρον, "ointment," and βαλανος, "acorn," as being in the form of acorns, and uſed in medicine.

MYRON, an excellent Grecian ſtatuary, flouriſhed 442 B. C. The cow he repreſented in braſs was an admirable piece of workmanſhip, and was the occaſion of many fine epigrams in Greek.

MYROXYLON, in botany: A genus of the monogynia order, belonging to the decandria claſs of plants. The calyx is campanulated; the ſuperior petal larger than the reſt; the germ is longer than the corolla; the legumen monoſpermous. There is but one ſpecies, the peruiferum, a native of Peru and the warmer parts of America. It is this ſhrub that yields the balſam of Peru, which is ſaid to be extracted from it by coction in water. This balſam, as brought to us, is nearly of the conſiſtence of thin honey, of a reddiſh brown colour, inclining to black, an agreeable aromatic ſmell, and a very hot biting taſte. Diſtilled with water, it yields a ſmall quantity of a fragrant eſſential oil of a reddiſh colour, and in a ſtrong fire, without addition, a yellowiſh red oil. Balſam of Peru is a very warm aromatic medicine, conſiderably hotter and more acrid than copaiva. Its principal effects are to warm the habit, to ſtrengthen the nervous ſyſtem, and attenuate viſcid humours. Hence its uſe in ſome kinds of aſthmas, gonorrhœas, dyſenteries, ſuppreſſions of the uterine diſcharges, and other diſorders proceeding from a debility of the ſolids or a ſluggiſhneſs and inactivity of the juices. It is alſo employed externally, for cleanſing and healing wounds and ulcers, and ſometimes againſt palſies and rheumatic pains.—There is another ſort of balſam of Peru of a white colour,

Myrrh. colour, and conſiderably more fragrant than the former. This is very rarely brought to us. It is ſaid to be the produce of the ſame plant which yields the common or black balſam, and to exſude from inciſions made in the trunk, while the former is obtained by boiling. There is alſo a third kind, commonly called the red or dry. This is ſuppoſed to obtain a different ſtate from the white, merely in conſequence of the treatment to which it is ſubjected after it is got from the tree. It is almoſt as fragrant as the balſam of Gilead, held in ſo high eſteem among the eaſtern nations. It is very rarely in uſe in Britain, and almoſt never to be met with in our ſhops.

MYRRH, a gummy-reſinous concrete juice, obtained from an oriental tree of which we have as yet no certain account. It comes over to us in globes or drops, of various colours and magnitudes. The beſt ſort is ſomewhat tranſparent, friable, in ſome degree unctuous to the touch, of an uniform browniſh or reddiſh-yellow colour, often ſtreaked internally with whitiſh ſemicircular or irregular veins; of a moderately ſtrong, not diſagreeable ſmell; and a lightly pungent, very bitter taſte, accompanied with aromatic flavour, but not ſufficient to prevent its being nauſeous to the palate. There are ſometimes found among it hard ſhining pieces, of a pale yellowiſh colour, reſembling gum-arabic, of no taſte or ſmell: ſometimes maſſes of bdellium, darker coloured, more opaque, internally ſofter than the myrrh, and differing from it both in ſmell and taſte: ſometimes an unctuous gummy reſin, of a moderately ſtrong ſomewhat ungrateful ſmell, and a bitteriſh very durable taſte, obviouſly different both from thoſe of bdellium and myrrh: ſometimes likewiſe, as Cartheuſer obſerves, hard compact dark-coloured tears, leſs unctuous than myrrh, of an offenſive ſmell, and a moſt ungrateful bitterneſs, ſo as, when kept for ſome time in the mouth, to provoke reaching, though ſo reſinous, that little of them is diſſolved by the ſaliva. Great care is therefore requiſite in the choice of this drug. Myrrh.

We have, as already obſerved, no certain information concerning the tree from which this ſubſtance flows; we are only told that the myrrh-tree, or plant, is a native of Abexim in Ethiopia, and is named *bedoins* by the Arabs. It is affirmed by ſome, that the myrrh we have at preſent is not equal in quality to that of the ancients, and has not that exquiſite ſmell which all authors aſcribe to the latter. They aromatized their moſt delicious wines with it; and it was preſented as a very valuable perfume to our Lord while he lay in the manger (A). But to this it may be eaſily anſwered, that there is no diſputing about perfumes any more than about taſtes and colours. Men are equally changeable with regard to ſmells, of which we have ſtriking examples in muſk and civet (B). The ancients reckoned two kinds of myrrh: the one li-

(A) It was this gum alſo which was mingled with the wine given him to drink at his paſſion, to deaden his pains, and produce a ſtupor. (See Mark xv. 23.) The gall mentioned on the ſame occaſion by St Matthew is probably the ſame with myrrh; for any thing bitter was uſually diſtinguiſhed by the name of gall. The Hebrews were accuſtomed to give thoſe that were executed ſome ſtupefying draught. The difficulty which ariſes from the ſeeming difference betwixt the two evangeliſts, by ſome is ſolved by ſaying, that St Matthew, writing in Syriac, made uſe of the word *marra*, which ſignifies "myrrh, bitterneſs, or gall;" but the Greek tranſlator has taken it for gall, and St Mark for myrrh. Others will have it, that our Saviour's drink was mingled with myrrh, as a ſtupefying drug; but ſuppoſe that the ſoldiers, out of wanton cruelty and inhumanity, infuſed gall; which was the reaſon, ſay they, why, when he had taſted, he refuſed to drink.

(B) In the *Journal de Phyſique*, &c. *Suppl.* tom. xiii. 1778, we find ſome remarks on myrrh, made by Mr Bruce while in Abyſſinia, of which the following is a ſtatement: The ſame remarks have been ſince publiſhed in the Appendix to his Travels. The ancients, and particularly Dioſcorides, who ſpeak of myrrh, ſeem never to have ſeen it; or at leaſt that which they have ſeen and deſcribed is altogether unknown to modern phyſicians and naturaliſts. The Arabians, however, who form the intermediate link in the chain between the Greek phyſicians and thoſe of our days, among whom this ſubſtance grew, and from whom it received its name, afford an inconteſtable proof that the myrrh with which we are acquainted is in no reſpect different from that of the ancients, being produced in the ſame countries from which the Greeks formerly procured theirs; that is, on the eaſtern ſhores of Arabia Felix; on the coaſts of the Indian ocean; and on that part of Lower Abyſſinia which lies to the ſouth-eaſt of the Red-ſea, nearly between the 12th and 13th degrees of north latitude, bounded on the weſt by a meridian running through the iſland of Maſſovia, and on the eaſt by one which paſſes through Cape Guardfey in the ſtraits of Babel-mandel. This region the Greeks called *Troglodytria*, and muſt be diſtinguiſhed from the country of the Troglodites, a nation different in every reſpect, and inhabiting the foreſts between Abyſſinia and Nubia. The Abyſſinian myrrh was always more valued than that of Arabia; and this preference it ſtill retains to the preſent day. That part of Abyſſinia being partly overflowed with water, and partly deſert and over-run by a barbarous nation from the ſouth, the Arabians have very little intercourſe with it except by means of ſome Mahometan merchants, whoſe deſperate adventures, undertaken on chance, ſometimes turn out well, but oftener prove very unfortunate. The iſland of Maſſova is the common medium of exportation for the Troglodite myrrh; but ſo little is brought from it in compariſon with what is ſent from Arabia to Grand Cairo, that this is certainly the only reaſon which can be aſſigned for the inferiority of our myrrh to that of the ancients, who received it from Abyſſinia. Although theſe barbarians employ the gum, leaves, and bark of this tree in many diſeaſes to which they are ſubject, as it is the moſt common tree in the country, they nevertheleſs cut it down and burn it for domeſtic purpoſes; and as they never plant new trees to replace thoſe which they have cut down, it is probable that in a few years the

Myrrh. quid, which they called *ſtacté* or *ſtarti*; the other was ſolid, and went by the name of *troglodite myrrh*. The ſtacte was procured by inciſion, and was received in veſſels very cloſely ſhut. Large pieces ſometimes preſent externally, or contain a kind of oily juice to which likewiſe the moderns give the name of *Stacté*. To prevent this juice from hardening, or at leaſt in a very ſmall degree, it is ſufficient to exclude it from the contact of the air immediately after its iſſuing from the tree; and by theſe means its aromatic nature will be much better preſerved (c). Myrrh.

The medical effects of this aromatic bitter are to warm

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the true Troglodite myrrh will be entirely loſt; and the erroneous deſcriptions of the ancient Greeks will lead poſterity, as it has done us, to form many miſtaken conjectures concerning the nature of the myrrh of the ancients.

Though the Troglodite myrrh was ſuperior to every ſpecies of Arabian myrrh, the Greeks plainly perceived that it was not all of the ſame quality. Pliny and Theophraſtus affirm, that this difference was owing to the trees, ſome of which were wild, and others meliorated by culture: but this is a mere conjecture; for the truth is that none of them are cultivated. The quality of the drug formerly depended, and muſt ſtill depend, on the age and ſoundneſs of the tree, on the way of making the inciſion, and on the ſeaſon of the year, and the temperature of the air when the myrrh is gathered. To have the firſt and moſt perfect kind of myrrh, the natives ſelect a young vigorous tree, free from moſs or any other plant adhering to the bark, and make a deep inciſion with a hatchet above the firſt large branches. What runs from this wound the firſt year, is myrrh of the firſt growth, and is never plentiful. This operation is performed ſome time after the rains have ceaſed, that is from April to June; and the myrrh is produced in July and Auguſt. At each return of the ſeaſon, the ſap continues to run in the courſe to which it has been accuſtomed; but the tropical rains, which are very violent, and which laſt for ſix months, convey ſo much filth and water into the inciſion, that by the ſecond year the tree begins to rot at that place; ſo that the myrrh is of a ſecondary quality, and at Cairo does not bring ſo great a price by a third as the myrrh of the firſt year. That which iſſues from inciſions near the roots and in the trunks of old trees is of the ſecond growth and quality, and ſometimes worſe; but it is reckoned good myrrh in the ſhops of Italy every where except Venice. It is of a red blackiſh colour, dirty, ſolid, and heavy. It loſes very little of its weight by being long kept, and can ſcarcely be diſtinguiſhed from that of Arabia Felix. The third and worſt kind is that which flows from old inciſions formerly made in old trees, or which not having been at firſt obſerved, has remained a whole year upon the tree. It is black, heavy, and of an earthy colour: it has little ſmell and bitterneſs, and is probably the *caucalis* of the ancients.

Myrrh newly gathered has always a ſtrong ſmell of rancid oil; and when put into water, globules of an oily ſubſtance are detached from it, which riſe and ſwim on the ſurface. This oilineſs does not ariſe from the myrrh, but from being put by the natives into goats ſkins, which they anointed with butter to make them pliant. It is kept in theſe ſkins, and thus carried to market: ſo that inſtead of being a fault, as ſome ſuppoſe, it is a proof that the myrrh is newly gathered; which is the beſt property that myrrh of the firſt kind can have. Beſides, this oily covering muſt have retained the volatile particles of the freſh myrrh, which eſcape in ſuch abundance as frequently to occaſion a conſiderable diminution in the weight.

(c) Pliny ſpeaks of the ſtarti as a recent or liquid myrrh: and Dioſcorides, chap. 67. ſays nearly the ſame thing. Mr Bruce is of opinion (but we think he is miſtaken), that the ancient Greeks and Romans, who lay at ſo great a diſtance, could never have it in that ſtate; becauſe he was aſſured by the natives, that it hardened on the tree as ſoon as it was expoſed to the air; and becauſe, though he was near the place where it grows, he never ſaw it ſofter than it is commonly found. Dioſcorides mentions likewiſe a ſpecies of myrrh, which, he ſays, is green, and has the conſiſtence of paſte. Serapio and the Arabians affirm, that ſtarti was a preparation of myrrh diſſolved in water: hence Mr Bruce conjectures, that this green unknown ſpecies was likewiſe a compoſition of myrrh and ſome other ingredient; and by no means a kind of Abyſſinian myrrh which they could never ſee either green or ſoft. The ſame author ſuppoſes, that *apocalbaſum*, or gum of Saſſa and myrrh, are one and the ſame ſubſtance; and he alleges, that Arabic myrrh may be diſtinguiſhed from myrrh of Abyſſinia in the following manner: A handful of the very ſmall pieces which are found at the bottom of the packet containing the myrrh, is thrown into a baſon with a ſufficient quantity of warm water to cover them. Here the myrrh remains for ſome time without any perceptible change, becauſe it diſſolves ſlowly; whereas the gum ſwells to five times its original ſize, and appears like ſo many white particles among the myrrh. But nothing can be inferred from this diſtinction. Does the Arabian myrrh diſſolve, and that of Abyſſinia ſwell? In that caſe the Arabian myrrh would act like pure gum Arabic, or acacia gum, and that of Abyſſinia like gum tragacanth. To us it appears, that Mr Bruce, of whoſe zeal and labours in other reſpects we entertain a high opinion, has not performed his experiments with ſufficient care; or if there was no miſtake in them, we muſt be allowed to think, that the ſuppoſed myrrhs which he employed were nothing but a mixture of Arabian gum acacia, and gum of Baſſora, or Egyptian tragacanth. We are more inclined to be of this opinion, when he ſays that the branches, leaves, and bark of the myrrh tree were brought to him by naked ſavages from the country of the Troglodites; and that he found that the leaves and bark bore a great reſemblance to the acacia vera. Among theſe leaves he obſerved ſome ſtraight prickles, about two inches in length. He likewiſe mentions, that he ſaw a ſaſſa tree which was a native of the myrrh country, and covered with beautiful crimſon-coloured flowers. We know that the ſhrub which produces the gum tragacanth is prickly, and has flowers ſomewhat of a purple colour.

Myrrh || Myrtus.

warm and ſtrengthen the viſcera: it frequently occaſions a mild diaphoreſis, and promotes the fluid ſecretions in general. Hence it proves ſerviceable in languid caſes, diſeaſes ariſing from a ſimple inactivity, thoſe female diſorders which proceed from a cold, mucous, ſluggiſh indiſpoſition of the humours, ſuppreſſions of the uterine diſcharges, cachectic diſorders, and where the lungs and thorax are oppreſſed by viſcid phlegm. Myrrh is likewiſe ſuppoſed in a peculiar manner to reſiſt putrefaction in all parts of the body; and in this light ſtands recommended in malignant, putrid, and peſtilential fevers, and in the ſmall-pox; in which laſt it is ſaid to accelerate the eruption.

The preſent practice does not ſeem to expect any peculiar virtue from myrrh; and it is now perhaps leſs employed than formerly. Some late writers, however, and particularly Dr Simmons, in his treatiſe on Conſumptions, have beſtowed very high encomiums on it, even in caſes of tuberculous phthiſis; and although it can by no means be repreſented as a remedy much to be depended on, yet there is reaſon to believe that it has been ſerviceable in ſome caſes.

Rectified ſpirit extracts the fine aromatic flavour and bitterneſs of this drug, and does not elevate any thing of either in evaporation: the gummy ſubſtance left by this menſtruum has a diſagreeable taſte, with ſcarcely any of the peculiar flavour of the myrrh: this part diſſolves in water, except ſome impurities which remain. In diſtillation with water, a conſiderable quantity of a ponderous eſſential oil ariſes, reſembling in flavour the original drug. Myrrh is the baſis of an officinal tincture. It enters the pilulæ ex aloe et myrrha, the pilulæ e gummi, and pilulæ ſtomachicæ, and ſome other formulæ. But for obtaining its full effects, it muſt be given in doſes of half a dram or upwards: and it is thought to be advantageouſly united with a proportion of nitre, cream of tartar, or ſome other refrigerant ſalt.

MYRRHINE, or MURRINE. See MURRINE.

MYRSINE, in botany: A genus of the monogynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 18th order, *Bicornes*. The corolla is ſemiquinquefid and connivent; the germen filling the corolla; the berry quinquelocular and pentaſpermous.

MYRTIFORM, in anatomy, an appellation given to ſeveral parts, from their reſembling myrtle-berries.

MYRTIS, a Greek woman who diſtinguiſhed herſelf by her poetical talents. She flouriſhed about 500 years before the Chriſtian era, and inſtructed the celebrated Corinna in the ſeveral rules of verſification. Pindar himſelf, as ſome report, was alſo one of her pupils.

MYRTLE, in botany. See MYRTUS.

MYRTOUM MARE, a part of the Ægean ſea, lying between Eubœa, Peloponneſus, and Attica. It receives this name from Myrto a woman, or from Myrtos a ſmall iſland in the neighbourhood, or from Myrtilus the ſon of Mercury who was drowned there, &c.

MYRTUS (anc. geog.), a ſmall iſland near Caryſtus in Eubœa, which gave name to the Mare Myrtoum. Others, according to Pauſanias, derive the appellation from *Myrto*, the name of a woman. Strabo extends this ſea between Crete, Argia, and Attica. Pauſanias beginning it at Eubœa, joins it at Helena, a deſart iſland, with the Ægean ſea. Ptolemy carries it to the coaſt of Caria. Pliny ſays, that the Cyclades and Sporades are bounded on the weſt by the Myrtoan coaſt of Attica. Myrtus.

MYRTUS, in botany, the *Myrtle:* A genus of the monogynia order, belonging to the icoſandria claſs of plants; and in the natural method ranking under the 19th order, *Heſperideæ*. The calyx is quinquefid, ſuperior; there are five petals; the berry is diſpermous or triſpermous. There are 14 ſpecies, of which the moſt remarkable are,

1. The communis, or common myrtle-tree, riſes with a ſhrubby, upright, firm ſtem, branching numerouſly all around into a cloſe full head, riſing eight or ten feet high; very cloſely garniſhed with oval-lanceolate, entire, moſtly oppoſite leaves, from half an inch to an inch and a half long, and one broad, on ſhort footſtalks; and numerous, ſmall, pale flowers from the axillas, ſingly on each footſtalk, having diphyllous involucrums; each flower ſucceeded by a ſmall, oval, dark-purple berry. The moſt material varieties are, broad-leaved Roman myrtle, with oval, ſhining, green leaves, an inch and an half long, and one broad; and which is remarkably floriferous. Gold-ſtriped broad-leaved Roman myrtle. Broad leaved Dutch myrtle, with ſpear-ſhaped, ſharp pointed, dark-green leaves, an inch long, and about three quarters of one broad. Double-flowered Dutch myrtle. Broad-leaved Jews myrtle, having the leaves placed by threes at each joint; by which particular circumſtance this ſpecies is in univerſal eſtimation among the Jews in their religious ceremonies, particularly in decorating their tabernacles; and for which purpoſe many gardeners about London cultivate this variety with particular care, to ſell to the above people, who are often obliged to purchaſe it at the rate of ſixpence or a ſhilling for a ſmall branch: for the true ſort, having the leaves exactly by threes, is very ſcarce, and is a curioſity; but by care in its propagation, taking only the perfectly ternate-leaved ſhoots for cuttings, it may be increaſed faſt enough; and is worth the attention of the curious, and particularly thoſe who raiſe myrtles for the London markets. Orange-leaved Spaniſh myrtle, with oval ſpear-ſhaped leaves, an inch and a half long or more, and one broad, in cluſters round the branches, and reſemble the ſhape and colour of orange-tree leaves. Gold-ſtriped leaved orange myrtle. Common upright Italian myrtle, with its branches and leaves growing more erect, the leaves oval, lanceolate-ſhaped, acute-pointed, and near an inch long and a half one broad. Silver-ſtriped upright Italian myrtle. White-berried upright Italian myrtle. Portugal acute-leaved myrtle, with ſpear-ſhaped, oval, acute-pointed leaves, about an inch long. Box-leaved myrtle, with weak branches, ſmall, oval, obtuſe, lucid-green, cloſely-placed leaves. Striped box-leaved myrtle. Roſemary-leaved myrtle, hath erect branches, ſmall, narrow, lanceolate, acute-pointed, ſhining, green, very fragrant leaves. Silver-ſtriped roſemary-leaved myrtle. Thyme-leaved myrtle, with very ſmall cloſely-placed leaves. Nutmeg-myrtle, with erect branches and leaves; the leaves oval, acute-pointed, and finely ſcented like a nutmeg. Broad-leaved nutmeg-myrtle. Silver-ſtriped leaved ditto. Criſtated or cock's-comb myrtle, frequently called *bird's-neſt myrtle*,

Myrtus. *myrtle*, hath narrow, ſharp-pointed leaves, criſtated at intervals. Theſe are all beautiful ever-green ſhrubs of exceeding fragrance; exotics originally of the ſouthern parts of Europe, and of Aſia and Africa, and conſequently in this country require ſhelter of a green houſe in winter: all of which, though rather of the ſmall-leaved kind, have their foliage cloſely placed, and remain all the year, and are very floriferous in ſummer; and when there is a collection of the different ſorts, they afford an agreeable ſource of variety with each other. They therefore claim univerſal eſteem as principal green houſe plants, eſpecially as they are all ſo eaſily raiſed from cuttings, and of ſuch eaſy culture, as to be attainable in every garden where there is any ſort of green-houſe, or garden-frames furniſhed with glaſſes for protecting them in winter from froſt: but ſome of the broad-leaved ſorts are ſo hardy as to ſucceed in the full ground, againſt a ſouth wall and other warm expoſures, all the year, by only allowing them ſhelter of mats occaſionally in ſevere froſty weather: ſo that a few of theſe ſorts may alſo be exhibited in a warm ſituation in the ſhrubbery: obſerving, however, all the ſorts are principally to be conſidered as green-houſe plants, and a due portion of them muſt always remain in pots to move to that department in winter.

Plate ccccxxxvi 2. The pimenta, pimento, Jamaica pepper, or all ſpice tree, grows above 30 feet in height and two in circumference; the branches near the top are much divided and thickly beſet with leaves, which by their continual verdure always gives the tree a beautiful appearance: the bark is very ſmooth externally, and of a grey colour; the leaves vary in ſhape and in ſize, but are commonly about four inches long, veined, pointed, elliptical, and of a deep ſhining green colour; the flowers are produced in bunches or panicles, and ſtand upon ſubdividing or trichotomous ſtalks, which uſually terminate the branches; the calyx is cut into four roundiſh ſegments; the petals are alſo four, white, ſmall, reflex, oval, and placed oppoſite to each other between the ſegments of the calyx; the filaments are numerous, longer than the petals, ſpreading, of a greeniſh white colour, and riſe from the calyx and upper part of the germen; the antheræ are roundiſh, and of a pale yellow colour; the ſtyle is ſmooth, ſimple, and erect; the ſtigma is obtuſe; the germen becomes a round ſucculent berry, containing two kidney-ſhaped flattiſh ſeeds. This tree is a native of New Spain and the Weſt India iſlands. In Jamaica it grows very plentifully; and in June, July, and Auguſt, puts forth its flowers, which, with every part of the tree, breathes an aromatic fragrance. The berries when ripe are of a dark purple colour, and full of a ſweet pulp, which the birds devour greedily, and muting the ſeeds, afterwards propagate theſe trees in all parts of the woods. It is thought that the ſeeds paſſing through them, in this manner, undergo ſome fermentation, which fits them better for vegetating than thoſe gathered immediately from the tree.

The pimento is a moſt beautiful odoriferous evergreen, and exhibits a fine variety in the ſtove at all ſeaſons. It was firſt introduced and cultivated in this country by Mr Philip Miller in 1739. With reſpect to flowering, all the varieties of the *myrtus communis* flower here in July and Auguſt, moſt of which are very floriferous: the broad-leaved Roman kind in particular is often covered with flowers, which in ſome of the ſorts are ſucceeded here by berries ripening in winter. The pimento alſo flowers in the ſtove with great beauty and luxuriance. The flowers of moſt of the ſorts are ſmall, but numerous; and are all formed each of five oval petals and many ſtamina. As all theſe plants require protection in this country, they muſt be kept always in pots, for moving to the proper places of ſhelter, according to their nature; the *myrtus communis* and varieties to the green-houſe in winter, the pimento and other delicate kinds to the ſtove, to remain all the year: therefore let all the ſorts be potted in light rich earth; and as they advance in growth, ſhift them into larger pots, managing the myrtles as other green-houſe ſhrubs, and the ſtove-kinds as other woody exotics of the ſtove. Myrtus.

Properties, &c. The leaves and flowers of *common* upright myrtle have an aſtringent quality, and are uſed for cleanſing the ſkin, fixing the teeth when looſened by the ſcurvy, and ſtrengthening the fibres. From the flowers and young tops is drawn a diſtilled water that is deterſive, aſtringent, coſmetic, and uſed in gargles. A decoction of the flowers and leaves is applied in fomentations. The berries have a binding deterſive quality; and the chemical oil obtained from them is excellent for the hair, and uſed in pomatums and moſt other external beautifiers of the face and ſkin. As an internal medicine, theſe berries have little or merit.

In the *Dictionnaire portatif d' Hiſtoire Naturelle*, a fact is related, which, if true, tends to ſhow the ſtrongly aſtringent quality of myrtle. "Myrtle (ſays he) is likewiſe the baſe of a pommade called *pommade de la Comteſſe*, and well known on account of an extraordinary hiſtorical fact. One of thoſe gay youths who flutter about the toilets of the fair, happened one day to be left alone in the ſtorehouſe of the graces. With eager curioſity he examined the perfumes, the ſmelling bottles, the perfumed powder, the eſſences, and the coſmetics. To give more of the vermilion and greater pliancy to his lips, and to remove ſome diſagreeable eruptions, he lightly ſpreads with his indiſcreet finger the fatal pommade, looks at himſelf in the glaſs, and contemplates his beauty with admiration. The lady enters; he wiſhes to ſpeak, but his lips contracted, and he could only ſtammer. The lady looked at him with aſtoniſhment; at length caſting her eyes on the toilet, ſhe diſcovered by the open pot the cauſe of the miſtake, and enjoyed a hearty laugh at the expence of her admirer, whoſe confuſion announced his indiſcretion."

Pimento berries are chiefly imported into Britain from Jamaica; whence the name *Jamaica pepper*. It is alſo called *all-ſpice*, from its taſte and flavour being ſuppoſed to reſemble thoſe of many different ſpices mixed together. It is one of the ſtaple articles of Jamaica; where the pimento walks are upon a large ſcale, ſome of them covering ſeveral acres of ground. When the berries arrive at their full growth, but before they begin to ripen, they are picked from the branches, and expoſed to the ſun for ſeveral days, till they are ſufficiently dried; this operation is to be conducted with great care, obſerving that on the firſt and ſecond day's

expoſure

Myſia || Myſore

expoſure they require to be turned very often, and always to be preſerved from rain and the evening dews. After this proceſs is completed, which is known by the colour and rattling of the ſeeds in the berries, they are put up in bags or hogſheads for the market. This ſpice, which was at firſt brought over for dietetic uſes, has been long employed in the ſhops as a ſuccedaneum to the more coſtly oriental aromatics: it is moderately warm, of an agreeable flavour, ſomewhat reſembling that of a mixture of cloves, cinnamon, and nutmegs. Diſtilled with water it yields an elegant eſſential oil, ſo ponderous as to ſink in the water, in taſte moderately pungent, in ſmell and flavour approaching to oil of cloves, or rather a mixture of cloves and nutmegs. To rectified ſpirit it imparts, by maceration or digeſtion, the whole of its virtue: in diſtillation it gives over very little to this menſtruum, nearly all its active matter remaining concentrated in the inſpiſſated extract. Pimento can ſcarcely be conſidered as a medicine: it is, however, an agreeable aromatic, and on this account is not unfrequently employed with different drugs, requiring ſuch a grateful adjunct. Both the pharmacopœias direct an aqueous and ſpirituous diſtillation to be made from theſe berries, and the Edinburgh college order alſo the *oleum eſſentiale piperis Jamaicenſis*.

MYSIA, a country of Aſia Minor, generally divided into Major and Minor. Myſia Minor was bounded on the north and weſt by the Propontis and Bithynia, and Phrygia on the ſouthern and eaſtern borders. Myſia Major had Æolia on the ſouth, Ægean on the weſt, and Phrygia on the north and eaſt. Its chief cities were Cyzicum, Lampſacus, &c. The inhabitants were once very warlike; but they greatly degenerated, and the words *Myſorum ultimus* was emphatically uſed to ſignify a perſon of no merit. The ancients generally hired them to attend their funerals as mourners, becauſe they were naturally melancholy and inclined to ſhed tears. They were once governed by monarchs. They are ſuppoſed to be deſcended from the Myſians of Europe, a nation who inhabited that part of Thrace which was ſituated between Mount Hæmus and the Danube.

MYSON, a native of Sparta, one of the ſeven wiſe men of Greece. When Anacharſis conſulted the oracle of Apollo, to know which was the wiſeſt man in Greece, he received for anſwer, he who is now ploughing his fields. This was Myſon.

MYSORE, or Mysorean dominions, a kingdom of Aſia, in the Eaſt Indies, conſiſting of the following territories uſurped or ſubdued by the late Hyder Ali, and tranſmitted to his ſon Tippoo Saib the preſent ſultan.

1. Myſore Proper, or Seringapatam (from its capital), forming the independent ſtate of a Hindoo rajah for near 200 years from its diſmemberment, as a province of the Bejenagur empire, fell into the hands of Hyder Ali Khan about the year 1763, by cutting off the Dalaway, or regent uſurper of the government, and ſeizing the reins of adminiſtration himſelf; but without leaving even the ſhadow of any authority to a nominal rajah of his own creation, excepting in the formularies of juſtice or finance, and preſerving on one ſide of the pagoda coin the impreſſion of two ſwamies or divinities of the Hindoos, while the other was made to bear the initial letter of his proper name Hyder. The whole country, now again reduced into the form of a province dependent on the new Myſorean dominion of a muſſulman in the perſon of Tippoo, is bounded on the weſt by the Balagaut hills of Koork, and thoſe called Anemally, bordering the whole coaſt of Malabar; on the eaſt it frontiers with the Carnatic Payengaut and its dependencies along the Coromandel coaſt; and, on the north, with the pergunnahs of Serah, Bangalore, and Colar, belonging to the Carnatic-Balagaut-Bejapoury, in a longitudinal line little ſhort of 200 Engliſh miles. From this latter boundary, in a form nearly triangular, it ſtretches 240 miles towards the ſouth, where it terminates in a point at the extremity of Dindigul, near the paſs of Goodalore, through the Anemally hills, on the confines of Travancore, and within 100 miles of Cape Comorin. It partakes of the two great diviſions of country known in the Decan by the terms Balagaut and Payengaut, or upper and lower region. The former, comprehending the diſtricts immediately dependent on the capital, and 43 ſubordinate forts, chiefly on eminences, is but indifferently watered by the ſeveral branches of the Caveri, at no great diſtance from its ſource; and muſt therefore, as well as in conſequence of an elevated ſituation, precluded from foreign commerce, with ſcarcely any internal induſtry, be comparatively poor, as it is productive only of the ſmaller grains of joary and bajary, or a ſpecies of Indian corn, with the different kinds of vetches common to India; from all which, however, a nett revenue, in money or kind, of ſeven lacks of hoons or pagodas, being about 27 lacks of rupees, is computed to be forthcoming to the ſtate, after defraying the ordinary charges of collection, which here, as in the reſt of Hindoſtan, conſiſt chiefly of an eſtabliſhment of village peons or militia, reckoned 40,000 in number, for the whole province of Myſore, ſuppoſed to contain 15,400 ſquare geographic miles. The latter, or Payengaut diviſion, making ſcarcely a third part of this extenſive area, is better known to us under the name of Coimbatore, including the diſtricts of Caroor, Darampour, and Nameul, on both ſides of the Caveri, with the valley of Dindigul on the ſouth, and the great paſs of Palligautcherry towards Malabar on the weſt: it is extremely fertile and well cultivated; therefore, in proportion to its extent, more productive of revenue than the Balagaut territory, being eſtimated nett at 19 lacks of rupees. The rajahs of Koork, and other Pallygars among the Gauts, from Bidenore ſouth to Dindigul, occupy independently a conſiderable tract of country within the general deſcription of Tippoo's dominions: but which being inacceſſible to regular troops by hills or impervious woods, the Myſorean power hath never been able to conquer, further than to facilitate the catching of a few elephants yearly, by means of the natives.

2. Bedenore, or Ikeri, now Hydernagur, on the diſſolution of the Canarine empire, of which it was a part, became an independent ſtate under its Naicks of the race of Vencataputty, after which it fell under the divided female government of different rannies or queens, and ſo continued until conquered wholly by Hyder between the years 1763-5. This country is alſo divided into alagaut and Payengaut; the latter

Myſore. ſtretching 140 miles along the ſea-coaſt from Declah, or the river Cangrecora, being the northern frontier of Malabar, north to Honawar or Onore, on the confines of Soonda, in different breadths of plain territory, from 40 to 50 miles, but which may in all form an area of 3200 ſquare miles, ſtill retaining the ancient name of Canara, and including the ports of Mangalore, Barcelore, Onore, &c. The former or elevated diviſion beyond the Supramanny Gauts, and immediately dependent on the capital Bedenore, Hanampour, &c. is of great indefinite extent inland, on both ſides of the Tumbhudra; perhaps twice more conſiderable in ſize, though not proportionably ſo in value, to the maritime border. Both diviſions, however, allowing for a revenue eſtabliſhment of about 22,000 village peons, are aſſeſſed for ſeven lacks of Ikeri pagodas, which, at four rupees each, make a clear income to the exchequer of 28 lacks of rupees.

3. Soonda, in circumſtances of hiſtory or final conqueſt, might be placed under the preceding head; as alſo from a ſimilarity in its geographical deſcription, with only the difference of being on a much ſmaller ſcale. The Payengaut, from the diſtrict of Onore to the frontiers of Goa, along a ſea-coaſt of 60 miles, cannot comprehend above 1100 ſquare miles of territory, in which the port of Carwar may be conſidered the capital; while a much larger extent muſt be allowed for that portion of the diſtrict beyond the Gauts to the eaſtward. The whole revenue, however, of both diviſions, does not exceed two lacks of pagodas, or eight lacks of rupees.

4. Malabar. The country under this deſcription, and conquered by Hyder in 1765-6, excluſive of Koork, is altogether Payengaut; ſtretching along the ſhore from Declah ſouth to Cochin about 200 miles, and comprehending, in an area of perhaps 6000 ſquare miles, the Samery's territory of Calicut, with the petty ſtates of Cartinad, Cotiotie, Cherica, or Cananore, on the north, and the tributary kingdom of Cochin on the ſouth;—the whole rated at a revenue of five lacks of pagodas, or about 19 lacks of rupees, after allowing for the maintenance of 18,000 village peons.

5. Barah Mhal, or twelve pergunnahs, was one of the earlieſt conquered annexations of Hyder to the Myſorean dominion, though in the war of 1768 it was over-run and for a while in poſſeſſion of the company's troops. The whole circar or diſtrict of Jugdeo, compoſed of heights and valleys on the confines of the Balagaut and Payengaut Carnatics, being one of the ſeven dependencies of Ginjee ſubjected to the Mogul in 1698, was then ſubdivided into 17 pergunnahs, and aſſeſſed for a groſs revenue of 1,757,717 rupees. Of theſe ſubdiviſions, Amboor, Sautgur, &c. remain to the Payengaut: the reſt in the hands of Tippoo, may comprehend, excluſive of the poligarry of Shili Naick, about 1800 ſquare miles; but the nett revenue of the ſame territory, after defraying the ordinary expences of collection, does not exceed five lacks of rupees at preſent.

Theſe five provinces of the Myſorean empire, with the diſtricts of Bangalore, Colar, &c. of the Carnatic-Balagaut Bejapoory, formed the whole of Hyder's dominion in the war 1768; and were calculated then to yield in all a nett income of 119 lacks and an half of rupees, allowing an eſtabliſhment of 115,000 village peons to enforce the collections, and maintain internal peace Myſore.

6. Petty ſtates of Hindoo rajahs, ſituated on the weſt and north of the Hendery and Tumbhudra rivers, to the confines of Goa, and the Merhatta territories of Toorgul, Raibaug, and Meritch, forming the jageer of Perſeram Bow beyond the ſouthern branch of the Kiſtnah. Some of theſe rajahſhips had been entirely conquered by the Mogul; but the moſt conſiderable of them never were ſubdued by any Muſſulman power until Hyder's conqueſt of them between the years 1774-7, though different diſtricts from each may have been diſmembered for a while by the Mogul deputies of the Carnatic-Balagaut Bejapoory, and therefore annexed in the accounts of the revenue of that circar. The frontier forts, and dependencies, of Goojunder-gur, Darwar, Badamy, &c. near the ſouthern branch of the Kiſtnah towards the Merhattah dominion, compoſed at one time the jageer of Ragenaut Row, and have frequently changed their maſters. They fell ultimately to Tippoo at the peace of 1784, but he was forced to pay chout for them to the Peſhwa. On the whole, all theſe ſtates, of great indefinite extent and extremely poor, yield only a precarious revenue of 16 lacks of rupees to the Myſorean.

7. Carnatic Balagaut Bejapoory, conſiſting, under the Mogul, of one circar of the ſame name, and of which the capital was Serah. It comprehended 51 pergunnahs, of which Bangalore, Colar, &c. on the ſouth, were ſeized by Hyder, immediately when he poſſeſſed himſelf of Myſore; but Anantpour, Penekonda, &c. on the north, with the reſt of the Merhattah ſtate of Gooty, did not fall into his hands until the year 1776, when he overcame and made priſoner the proprietor Morarow, who had rendered ſignal ſervice to the Engliſh in the preceding Myſorean war. The whole circar was rated at a jumma *kaumil*, or total groſs revenue on the king's books, of 43916,396 rupees: but the accuracy of this valuation is much to be doubted; becauſe it does not appear from the regiſters of the ſoubah of Bejapour that the Mogul government ever aſcertained the *dehatee* or village collections of either of the Carnatics, or went into greater detail than to fix the ſtandard aſſeſſment of the different pergunnahs; and becauſe the amount thus ſtated ſeems too large a receipt from a country naturally ſo poor and deſtitute of commerce, probably in all its dimenſions not exceeding 10,000 ſquare miles, and which was ſo liable to internal diſturbances or foreign invaſion, that notwithſtanding the number of ſtrong holds to be found in it, every town required and has its own particular fortification. However this may be, the revenue actually forthcoming to Hyder in 1778, after defraying charges of collection and an eſtabliſhment of about 30,000 village peons, was only 3,205,206 rupees.

8. Carnatic-Balagaut-Hydrabady, comprehending the five circars of Sidhout, Kahmam, Ganjecottah, Gooty, and Gorrumkonda, which were ſubdivided into 66 pergunnahs, rated by the Moguls kaumils 4,707,306 rupees: but from this amount is to be deducted the aggregate valuation of the pergunnahs of Chittoor, &c. now annexed to the Payengaut, together with the aſſeſſment of the diamond-mines of Ganjecottah,

Myſore.

jecottah, which are no longer productive, making in all an object of two lacks of rupees. The whole country thus deſcribed, bounded by the circars of Adoni and Nundial on the north towards the Kiſtnah, the Guntour circar and Carnatic Payengaut on the eaſt, with that of the Balagaut Bejapoury on the ſouth and weſt, may in ſquare dimenſions be nearly equal to this laſt mentioned diviſion of territory of about 10,000 ſquare miles. It formed the inheritance for four generations of the Patan nabobs of Cuddapah, deſcended from a collateral branch of the Sanore family, until Gooty and Gorrumkonda were taken by the Merhattahs in 1758, and then ultimately, with the remainder of Helim Khan's poſſeſſion, by Hyder in 1776-9. After deducting the amount of a few jageers and ſome charitable lands ſtill left to the Mahomedans of this diſtrict, with the expence of an eſtabliſhment at leaſt of 23,000 village peons, the nett revenue of the whole province may be eſtimated at 29 lacks of rupees.

9. Adoni, or circar of Imtiazghur on both ſides of the Hendery river, ſouth of the Tumbhudra or Tungabudra river, as far as and incluſive of Bellary, together with a ſmall portion of the circar of Ghazipour or Nundial, diſmembered from the nabobſhip of Karnool, all ſituated in the ſoubah of Bejapour, comprehend the whole of Tippoo's conqueſts and annexation to the Myſorean empire, acquired ſince the death of Hyder, and ſubſequently to the treaty of Mangalore in 1784. In extent and revenue, this acquiſition may be conſidered of little account. The former cannot exceed 5000 ſquare miles, and the latter ſcarcely ſeven lacks of rupees, reckoning the petty zemindary of Bellary. But the fort of Adoni is of conſiderable importance, as being of the kind (on an inſulated rock) thought the ſtrongeſt in Hindoſtan, without excepting Dowlatabad or Gualior. It was ever the favourite ambitious object of conqueſt to Hyder, the Merhattas and Nizam; and preſerved only through the cautious policy of its proprietor, Baſſalut Jung. When it came by inheritance into the weak inexperienced hands of his ſon Mohabet Jung, it fell by treachery under the dominion of Tippoo; together with all its territorial dependencies, except the circar of Raichore, between the Kiſtnah and Tumbhudra.

The extent of Tippoo's dominion, according to the lateſt maps, has been computed at 80,000 ſquare geographic miles, or 92,666 Engliſh. Thus conſidering it a triangle, of which the baſe runs nearly parallel to and not far ſouth of the Kiſtnah, in a longitudinal line of 340 Engliſh miles, about the 16th degree of north latitude, or from the pagoda of Tripanti in the north-eaſt angle to Kittoor in the north-weſt, towards the frontiers of Goa, of Bari, and the Merhattahs; then, one of its ſides, along the Balagaut or mountainous ridge of the Malabar coaſt, will be found to ſtretch in a horizontal diſtance 500 miles ſoutherly, to the extreme point and paſs of Goodalore in that quarter; and its other ſide from thence northerly, touching the frontiers of the Carnatic Payengaut, 470 miles in a parallel direction to the Coromandel coaſt, until it reaches the further corner of the circar of Kahmam near the firſt mentioned point at the pagoda of Tripanti. Beyond theſe three lines, the plains bordering the ſhores of Canara and Malabar are the only excluſive territory of conſiderable extent belonging to Tippoo: and to balance it in ſome degree, within the area of the triangle deſcribed, it is to be remembered are ſituated the independent or environed ſtates of Sanore, Koork, &c. if not alſo a part of Karnool and Raichore. As the whole face of the country is known to be rugged, in many parts deſolate, badly watered, and generally riſing abruptly near half a mile of perpendicular height above the level of the ſea, it cannot be ſuppoſed that the ſoil is equally fertile with the lower lands of Hindoſtan. In fact, though every advantage of induſtry and population be allowed to a deſpotic government, which cheriſhes a numerous peaſantry in excluſion of great intermediate landholders, yet the produce of the Balagaut altogether conſiſts merely of the neceſſaries of life, and theſe of the coarſeſt kind; juſt enough to ſubſiſt the inhabitants, after making ſufficient proviſion in paſture for the extraordinary number of horſes and other cattle maintained there for the military eſtabliſhment: while, in the Payengaut on the Malabar coaſt, ſome pepper, cardamums, ſandal wood, and ſurplus grain beyond internal conſumption, conſtitute the only commercial funds of natural growth within the whole circle of the Myſorean dominion. As to manufactures, except thoſe of Salem and Bellary, if any exiſt in the country, they are not conſiderable enough to be known abroad.

From the foregoing view of the nature, produce, and revenues of the Myſorean empire, it may be concluded that we could have no lucrative proſpects in our late conteſts with Tippoo Sultan; but were compelled, for the preſervation of our own poſſeſſions in that quarter, to undertake his reduction as a reſtleſs, cruel, ambitious, and depredatory neighbour. This has accordingly been effected by the good conduct of Lord Cornwallis; who, in the iſſue of the war, has obliged him to cede half his dominions to the Company and its allies, adjacent to their reſpective boundaries, and ſubject to their ſelection.

MYSTERIES.

1 The gradual introduction of myſteries into religion.

RELIGION, in its original form, was ſimple and intelligible. It was intended for the inſtruction and edification of all ranks of men; and of conſequence its doctrines were on a level with vulgar capacities. The Jewiſh diſpenſation was openly practiſed: nothing was performed in ſecret; every article was plain, open, and acceſſible. The divine Author of the Chriſtian œconomy commanded his diſciples to preach his doctrine in the moſt public manner: "What ye have heard in ſecret (ſays he) preach openly; and what I have taught you in private teach ye publicly, and proclaim it on the houſe-tops." Such are the charms of truth, and ſuch the character of that religion which came down from heaven, that they, as it

were. "delight in the light, and lift up their voice in the ſtreets, and cry in the chief places of concourſe."

But ſuch is the depravity of the nature of man, that the nobleſt inſtitutions degenerate in his hands. Religion itſelf, originally pure, ſimple, and amiable, under his management has often been transformed into pollution, perplexity, and deformity. The miniſters of religion, whoſe province it was to guard the ſacred depoſit, and to ſecure it from foreign and ſpurious intermixtures, have generally been the firſt innovators, and the firſt and moſt induſtrious agents in corrupting its integrity and tarniſhing its beauty. Avarice and ambition prompted that claſs of men to deviate from the original plainneſs and ſimplicity of religious inſtitutions, and to introduce articles, rites, and uſages, which might furniſh them with opportunities of gratifying theſe unhallowed and inſatiable paſſions. Hence diſtinctions unknown to pure and undefiled religion were fabricated, and that heavenly inſtitution, heretofore one, ſimple, indiviſible, was divided into two partitions: the one popular and public; the other dark, ſecret, and myſterious. The latter of theſe we intend as the ſubject of this article.

2 Etymology and import of the term.

The Engliſh word *myſtery* is derived from the Greek μυστηριον; and in its modern acceptation imports ſomething above human intelligence, ſomething awfully obſcure and enigmatical; anything artfully made difficult; the ſecret of any buſineſs or profeſſion. The word is often uſed by the founder of the Chriſtian religion, and more frequently by his apoſtles, eſpecially St Paul. In theſe caſes, it generally ſignifies thoſe doctrines of Chriſtianity which the Jews, prior to the advent of the Meſſiah, either did not or could not underſtand. The Trinity in Unity, and the Unity in Trinity; the incarnation of the Son of God; the union of two natures in one and the ſame perſon, &c. we generally call *myſteries*, becauſe they are infinitely above human comprehenſion All theſe ſignifications are out of the

3 Object of this article.

queſtion at preſent Our intention in this article is to lay before our readers the fulleſt and faireſt account we have been able to collect, of thoſe απορρητα, or *ſecret rites*, of the pagan ſuperſtition, which were carefully concealed from the knowledge of the vulgar, and which are univerſally known under the denomination of *myſteries*.

The word Μυστηριον is evidently deduced from Μυστης; but the origin of this laſt term is not altogether ſo obvious. The etymologies of it exhibited by the learned are various; ſome of them abſurd and inconſiſtent, others fooliſh and futile. Inſtead of fatiguing our readers with a detail of theſe, which would be equally unintertaining and unintereſting, we ſhall only produce one, which to us appears to come neareſt the truth. The myſteries under conſideration at preſentwere certainly imported into Greece from the Eaſt. In thoſe regions, then, we ought of courſe to look for the etymology of the word. *Miſtor*, or *miſtur*, in Hebrew, ſignifies "any place or thing hidden or concealed." As this word implies a kind of definition of the nature of the thing intended, and as it is one of the excellencies of original languages to apply vocables with this propriety, we find ourſelves ſtrongly inclined to aſſign the word *miſtur* as the root of the term Μυστης, *myſter*.

4 Motives to the introduction of the myſteries.

We have already obſerved, that the avarice and ambition of the pagan prieſthood probably gave birth to the inſtitution of the myſteries. To this obſervation we may now add, that the miniſters of that ſuperſtition might poſſibly imagine, that ſome articles of their ritual were too profound to be comprehended by the vulgar: others, too ſacred to be be communicated to a deſcription of men whom the inſtitutions of civil ſociety had placed in a ſituation not only ſubordinate but even contemptible. It was imagined, that things ſacred and venerable would have contracted a taint and pollution by an intercourſe with ſordid and untutored ſouls. Theſe appear to us the moſt probable motives for making that odious and pernicious diſtinction between the popular religion and that contained in the ſacred and myſterious ritual.

The learned Biſhop Warburton is poſitive, that the myſteries of the Pagan religion were the invention of legiſlators † and other great perſonages, whom fortune or their own merit had placed at the head of thoſe civil ſocieties which were formed in the earlieſt ages in different parts of the world. It is with reluctance, and indeed with diffidence, that we preſume to differ in our ſentiments from ſuch reſpectable authority. Whatever hypotheſis this prelate had once adopted, ſo extenſive was his reading, and ſo exuberant his intellectual reſources, that he found little difficulty in defending it by an appearance of plauſibility, if not of rational argumentation. The large quotations he has adduced from Plato and Cicero, do indeed prove that the ſages and legiſlators of antiquity ſometimes availed themſelves of the influence derived from the doctrines of the myſteries, and from the authority they acquired by the opinion of their having been initiated in them; but that thoſe men were the inventors and fabricators of them, is a poſition for which his quotation do not furniſh the moſt ſlender preſumption. At the ſame time, we think it not altogether certain, that the doctrine of a divine Providence, and a future ſtate of rewards and puniſhments, were revealed in the myſteries with all the clearneſs and cogency which is pretended by his Lordſhip.

† *Divine Leg.*

5 The hypotheſis of Warburton ill founded.

But granting that the fabric was raiſed by the hands of ſages and legiſlators, we imagine it would be rather difficult to diſcover what emolument that deſcription of men could propoſe to derive from the enterpriſe.—The inſtitution was evidently, and indeed confeſſedly, deviſed to conceal from the million thoſe very doctrines and maxims, which, had they known and embraced them, would have contributed moſt effectually to diſpoſe them to ſubmit to thoſe wiſe regulations which their governors and legiſlators wiſhed moſt ardently to eſtabliſh. Experience has taught, that nothing has a more commanding influence on the minds of the vulgar, than thoſe very dogmas, which, according to the Biſhop, were communicated to the initiated. A conviction of the Unity of the Deity, of his wiſdom, power, goodneſs, omnipreſence, &c. the ſteady belief of the immortality of the human ſoul, and of a future ſtate of rewards and puniſhments, have in all ages, and in all countries, proved the firmeſt ſupports of legal authority. The very ſame doctrines, in the dawn of Chriſtianity, contributed of all other methods the moſt effectually to tame and civilize the

ſavage (A) inhabitants of the northern regions of Europe. Suppoſing thoſe principles to have been inculcated by the myſteries, the moſt prudent plan legiſlators could have adopted, would have been to publiſh them to all mankind. They ought to have ſent forth apoſtles to preach them to the ſavages whom they had undertaken to civilize. According to the learned prelate, they purſued the oppoſite courſe, and deprived themſelves of thoſe very arms by which they might have encountered and overthrown all the armies of ſavagiſm.

6 Myſteries of Eleuſis ſaid to be revealed publicly in Crete. * *Lib.* 5.

Of all the legiſlators of antiquity, the Cretan alone was prudent enough to ſee and adopt this rational plan. Diodorus the Sicilian informs us*, that the myſteries of Eleuſis, Samothracia, &c. which were elſewhere buried in profound darkneſs, were among the Cretans taught publicly, and communicated to all the world. Minos, however, was a ſucceſsful legiſlator; and his intercourſe with Jupiter Idæus extended his influence and eſtabliſhed his authority. He was not under the neceſſity of calling in the myſteries to his aſſiſtance: on the contrary, it is highly probable that the univerſal knowledge of the doctrines of the myſteries among his countrymen contributed in a conſiderable degree to facilitate his labour, and enſure his ſucceſs.

The divine Author of the Chriſtian œconomy, viewed in the light of a human legiſlator, ſaw the propriety of this procedure. Nothing was concealed in his inſtitutions; nothing was veiled with myſtery, or buried in darkneſs. The ſucceſs was anſwerable to the wiſdom of the plan. The million flocked to the evangelical ſtandard: the goſpel was preached to the poor, to the illiterate and the vulgar; and the meaneſt of mankind eagerly embraced its maxims. Wherever it prevailed, it produced civilization, morality, ſobriety, loyalty, and every other private and ſocial virtue.—Upon the ſuppoſition that the myſteries had contained and inculcated the principles and practices which the prelate ſuppoſes they did, the civilizers of mankind, legiſlators, magiſtrates, and princes, ought to have combined to make them public for the ſake of their own tranquillity, and the more effectual ſupport of their authority and influence.

7 Myſteries the offſpring of Egyptian prieſtcraft; but

Upon the whole, we are inclined to believe that the myſteries were the offspring of Egyptian prieſtcraft. They were inſtituted with a view to aggrandiſe that order of men, to extend their influence, and enlarge their revenues. To accompliſh thoſe ſelfiſh projects, they applied every engine towards beſotting the multitude with ſuperſtition and enthuſiaſm. They taught them to believe, that themſelves were the diſtinguiſhed favourites of heaven; and that celeſtial doctrines had been revealed to them, too holy to be communicated to the profane rabble, and too ſublime to be comprehended by vulgar capacities. It is, we confeſs, exceedingly probable, that after the myſteries were inſtituted, and had acquired an exalted reputation in the world, legiſlators, magiſtrates, judges, and potentates, joined in the impoſture, with the ſame views and from the ſame principles. Princes and legiſlators, who found their advantage in overawing and humbling the multitude, readily adopted a plan which they found ſo artfully fabricated to anſwer theſe very purpoſes. They had intereſt enough with the ſacerdotal (B) myſtagogues, to induce them to allow them to participate in thoſe venerable rites which had already eſtabliſhed the authority of that deſcription of men in whoſe hands they were depoſited. The views of both parties were exactly congenial. The reſpect, the admiration, and dependence of the million, were the ultimate objects of their ambition reſpectively.—Prieſts and princes were actuated by the very ſame ſpirit. The combination was advantageous, and of conſequence harmonious. For theſe reaſons we have taken the liberty of differing from his lordſhip of Glouceſter with reſpect to the perſons who firſt inſtituted the ſecret myſteries of the Pagan religion.

8 adopted by legiſlators, &c.

9 Hypotheſis of Moſheim

Another writer, of conſiderable reputation in the republic of letters, is of opinion, that the myſteries were entirely commemorative; that they were inſtituted with a view to preſerve the remembrance of heroes and great men, who had been deified in conſideration of their martial exploits, uſeful inventions, public virtues, and eſpecially in conſequence of the benefits by them conferred on their contemporaries.—According to him, the (C) myſteries of Mithras were eſtabliſhed for this very purpoſe. It would be no difficult matter to prove that the Perſian deity of that name was the ſun, and that his name and inſignia jointly aſcertain the truth of this aſſertion. The ſame writer extends this obſervation to the myſteries of the Egyptians, Phœnicians, Greeks, Hetruſcans; and in a word, to all the inſtitutions of that ſpecies throughout the world. In oppoſition to this ſingular opinion, it may be argued, we think with ſome ſhow of reaſon, that the method of preſerving the memory of great and illuſtrious men generally adopted, was the eſtabliſhing feſtivals, celebrating games, offering ſacrifices, ſinging hymns, dances, &c. We can recollect no ſecret myſteries inſtituted for that purpoſe at leaſt in their original intention. If any uſage of the commemorative kind was admitted, it was ſuperinduced at ſome period poſterior to the primary inſtitution At the ſame time, upon the ſuppoſition that the orgia of Bacchus were the ſame with thoſe of the Egyptian Oſiris, and that the myſteries of Ceres exhibited at Eleuſis were copied from thoſe of the Egyptian Iſis, and allowing that the former was the ſun, and the latter the moon; it will be difficult to find out the human perſons whoſe exploits, adventures, inventions,

10 ſingular and indefenſible.

(A) The Germans, Ruſſians, and Scandinavians, who were never thoroughly civilized till the goſpel was preached among them.

(B) The myſtagogues were the miniſters who acted the chief part in celebrating the myſteries.

(C) Principio hoc ego quidem controverſia vacare, arbitror, myſteria quæ vocantur, ritus fuiſſe idcirco inſtitutos ne memoria petiret veterum beneficiorum, inventorum, fatorum rerum geſtarum quibus primi populorum conditores, aut alii præclari homines, decus nomen, et famam, inter ſuos ſibi comparaverant. Neque hæc cuiquam ſententia mirabilis videri poterit. *Cud. Syſt. Intellect. ed Moſhemii*, p. 329.

inventions, &c. were intended to be immortalized by those institutions. Upon the whole, the mysteries were performed in secret; they were intended to be communicated only to a few: of course, had they been instituted with a view to immortalize the memory of heroes and great men, the authors would have acted the most foolish and inconsistent part imaginable.—Instead of transmitting the fame of their heroes with eclat to posterity, they would by this procedure have consigned it to eternal oblivion.

11 Our first position supported by the character of the priests of Egypt.

We must then recur to our first position. The mysteries were the offspring of bigotry and priestcraft; they originated in Egypt, the native land of idolatry. In that country the priesthood ruled predominant. The kings were ingrafted into their body before they could ascend the throne. They were possessed of a third part * of all the land of Egypt. The sacerdotal function was confined to one tribe, and was transmitted unalienably from father to son. All the orientals, but more especially the Egyptians, delighted in mysterious and allegorical doctrines. Every maxim of morality, every tenet of theology, every dogma of philosophy, was wrapt up in a veil of allegory and mysticism. This propensity, no doubt, conspired with avarice and ambition to dispose them to a dark and mysterious system of religion. Besides, the Egyptians were a gloomy † race of men; they delighted in darkness and solitude. Their sacred rites were generally celebrated with melancholy airs, weeping, and lamentation. This gloomy and unsocial bias of mind must have stimulated them to a congenial mode of worship. In Egypt then we are to search for the origin of the mysteries. Both the nature of the institution and the genius of the people confirm this position; and historians, both ancient and modern, are agreed in admitting the certainty of the fact.

* *Diodor. Sicul. Lib.* 1.

† *Plutarch.*

12 The Osiris and Isis of Egypt the Bacchus and Ceres of Greece.

The Osiris of Egypt, every body knows, was the original Bacchus; as the Isis of the same country was the Ceres of the Greeks. The rites of Osiris were performed with loud shrieks and lamentations when he was put into the coffin; and with the most extravagant mirth, when he was in a manner raised from the dead, or supposed to be found again. Their hymns were upon the whole always composed in melancholy affecting strains; and consisted of lamentations for the loss of Osiris, the mystic flight of Bacchus, the wandering of Isis, and the sufferings † of the gods. The Canaanites, who were a kindred tribe of the Mizraim or Egyptians, imitated them in their sacred rites. At Byblus, Berytus, Sidon, and afterwards at Tyre, they used particularly mournful dirges for the death of Adonis or Tammuz †, who was the same with the Egyptian Osiris, *i. e.* the sun.

† *Plut. Is. et Osir.*

† *Ezek. Chap.* 8. *and Nonni Dionys.*

13 Death of Osiris and wanderings of Isis.

The Egyptians, then, naturally inclined to gloom and secrecy, instituted a mode of worship congenial with their natural disposition of mind. The recess of the sun towards the southern hemisphere, was the death † of Osiris; the wanderings of Isis in search of her husband and brother, allegorically imported the longings of the earth * for the return of the fructifying influences of the solar heat.

† *Macrob. Saturn.*

* *Plut. Is. et Osir.*

When that luminary returned towards the summer solstice, and grain, trees, fruits, herbs, and flowers adorned the face of nature, another festival was celebrated of a very different complexion from that of the former. In this season all Egypt was dissolved in the most extravagant mirth and jollity. During the celebration of those festivals, the priests formed allegorical representations of the sun and the earth (D). They personified the one and the other, and allegorized their motions, aspects, relations, sympathies, accesses, recesses, &c. into real adventures, peregrinations, sufferings, contests, battles, victories, defeats, and so forth. These, in process of time, were held up to the vulgar as real occurrences; and these in a few ages became the most essential articles of the popular creed. From this source were derived the conquests of Dionysus or Bacchus, so beautifully exhibited by Nonnus in his Dionysiacs; the wanderings of Io, wonderfully adorned by Æschylus; and the labours of Hercules, afterwards usurped by the Greeks.

14 The Egyptians deified departed heroes.

Whether the Egyptians deified mortal men in the earliest ages has been much controverted. Jablonski * has taken much pains to prove the negative. Diodorus ‡ assures us that they paid their monarchs a kind of divine adoration, even in their lifetime. Plutarch tells us plainly § that some were of opinion that Isis, Osiris, Horus, Anubis, Typhon, were once mortal persons, who were exalted into dæmons after their death. The Sicilian, in his history of Isis and Osiris, Pan, Hermes, &c. plainly represents them as human personages; and informs us, that the Egyptians imagined, that after their decease they transmigrated into particular stars. From these authorities, we are inclined to believe that the Egyptians, as well as the other pagans, did actually deify persons who had distinguished themselves in their days of nature by prowess, wisdom, useful arts, and inventions. This was a constant practice among the Greeks, who probably learned it from the people in question.

* *Panth. Egypt.*

‡ *Lib.* i.

§ *Is. et Osir.*

15 Secrets respecting the objects of worship revaled in the mysteries.

The exploits of those heroes had been disguised by allegorical traditions and hieroglyphical representations. They had been magnified beyond all dimensions, in order to astonish and intimidate the vulgar. They had been interlarded with the most extravagant fables, in order to gratify their propensity towards the marvellous. All these secrets were developed in the mysteries. The catechumens (E) were informed of every particular relating to the birth, the life, the exploits, the adventures, the misfortunes, and decease of those heroic personages, and when, and by what means, they had attained to the high rank of divinities. At the same time we think it highly probable, that those demigods were represented in their state of exaltation and heavenly splendour. The magicians of Egypt were abundantly qualified for exhibiting *angels in machines*. The souls of virtuous men, who had not been eminent enough to merit the honour of deification, were shown in all the perfection of Elysian felicity; and perhaps the

(D) Isis, among the Egyptians, sometimes signified the moon, and sometimes the earth.

(E) Catechumens were pupils who were learning the elements of any science.

the ſouls of tyrants, and of the children of (F) Typhon, were ſhown in Tartarus, ſuffering all the extremes of infernal puniſhment. From theſe exhibitions the myſtagogues might naturally enough take occaſion to read their pupils ſuitable lectures on the happy tendency of a virtuous conduct, and the diſhonour and miſery conſequent upon a contrary courſe. They might ſet before them immortal renown, deification, and elyſium, on the one hand, and eternal infamy and miſery on the other. This will probably be deemed the chief advantage accruing from this inſtitution.

16 Chief advantage of the myſteries.

Beſides the communications above-mentioned, the catechumens were taught many ſecrets of phyſiology, or the nature of the phenomena of the world. This Pharnutus * every where affirms, eſpecially in his laſt book towards the end. Plutarch too informs us, that many of the Greek philoſophers were of opinion, that moſt of the Egyptian fables were allegorical details of phyſical operations. Euſebius acquaints us §, that the phyſiology, not only of the Greeks, but likewiſe of the barbarians, was nothing elſe but a kind of ſcience of nature, a concealed and dark theology, involved in fable and fiction, whoſe hidden myſteries were ſo veiled over with enigmas and allegories, that the ignorant million were as little capable of comprehending what was ſaid as what was ſuppreſſed in ſilence. This, ſays he, is apparent from the poems of Orpheus and the fables of the Phrygians and Egyptians. Dionyſius of Halicarnaſſus likewiſe obſerves ‡, that the fables of the Greeks detail the operations of nature by allegories. Proclus § makes the ſame obſervation concerning the people in queſtion. The Egyptians, ſays he, taught the latent operations of nature by fables,

* *De Nat. Deorum.*

§ *Prep. Evangel.*

‡ *Antiq. Rom.*

§ *In Tim.*

17 Phyſiological ſecrets expounded in the myſteries of Egypt.

Theſe phyſiological ſecrets were no doubt expounded to the initiated; and that the Egyptian prieſts were deeply ſkilled in phyſiological ſcience, can ſcarce be queſtioned, if we believe that Jannes and Jambres rivalled Moſes with their enchantments. The preceding detail comprehends all that was revealed to the Epoptæ in the original Egyptian myſteries. What articles might have been introduced afterwards we cannot pretend to determine.

Be that as it may, one thing is certain, namely, that the vulgar were excluded from all thoſe choice ſecrets, which were carefully reſerved for the nobility and ſacerdotal tribes. To them it was given to know the myſteries of the kingdom of darkneſs; but to thoſe who were without, all was myſtery and parable. While the laity fed on huſks, the clergy and the quality feaſted on royal dainties. The prieſts who had deviſed theſe allegories underſtood their original import, and bequeathed it as an ineſtimable legacy to their children. Here then we have the primary object of the myſteries, namely, to develope to the initiated the original and rational import of thoſe allegorical and myſtical doctrines which were tendered to the uninitiated, wrapt up in impenetrable allegory and obſcurity. To the former, theſe were communicated and explained: The latter were obliged to ſtand at an awful diſtance, and retire as the *Procul, O procul eſte profani*, thundered in their ears.

Theſe allegorical traditions originated in Egypt, (ſee MYTHOLOGY). It was the general bias of the oriental genius. The Egyptians, however, according to the moſt authentic accounts (G), were the greateſt proficients in that ſcience. The original ſubject of theſe inſtitutions were, we imagine, the articles we have ſpecified above: but in proceſs of time, according to the natural courſe of things, numerous improvements were made, and many new rites, ceremonies, uſages, and even doctrines, were ſuperinduced, which were utterly unknown to the original hierophants (H). Simplicity is for the moſt part one of the diſtinguiſhing characters of a new inſtitution; but ſucceeding architects generally imagine that ſomething is ſtill wanting to complete the beauty, the regularity, the uniformity, the magnificence, and perhaps the conveniency of the ſtructure. Hence, at length, it comes to be ſo overloaded with adventitious drapery, that its primary elegance and ſymmetry is altogether defaced. This was the caſe with the earlieſt Egyptian myſteries. Their ſubject was at firſt ſimple and eaſy to be comprehended; in time it became complex, intricate, and unintelligible.

18 Temples where the myſteries were celebrated.

In order to celebrate thoſe myſteries with the greater ſecrecy, their temples were ſo conſtructed as to favour the artifice of the prieſts. The fanes, in which they uſed to execute their ſacred functions, and to perform the rites and ceremonies of their religion, were ſubterraneous apartments, conſtructed with ſuch wonderful ſkill and dexterity, that every thing that appeared in them breathed an air of ſolemn ſecrecy. Their walls were covered with hieroglyphic paintings and ſculpture, and the altar was ſituated in the centre of the apartment. Modern * travellers have of late years diſcovered ſome veſtiges of them, and bear witneſs to the above deſcription of thoſe dark abodes (I). In thoſe ſubterraneous manſions, which the prieſts of that ingenious nation had planned with the moſt conſummate ſkill, the kings, princes, and great men of the ſtate, encountered the dangers and hardſhips contrived to prove their prudence, fortitude, patience, abſtinence, &c. Theſe were appointed to try their merit; and by theſe the hierophants were enabled to decide whether or not they were duly qualified for receiving that benefit. Upon thoſe occaſions, we may believe, abundance of thoſe magical tricks were exhibited, for which the magicians of Egypt were ſo much celebrated among the ancients. The ſtrange and aſtoniſhing ſights, the alternate ſucceſſions of light and darkneſs, the hideous ſpectres expoſed to view, the frightful howlings re-echoed by theſe infernal domes, the ſcenes of Tartarus and

* *Nardon, Shaw, Pococke, &c.*

(F) Typhon was the evil genius, or devil of the Egyptians.

(G) As early as the age of Joſeph, the Egyptians were ſkilled in the interpretations of dreams, divinations, &c. and in the age of Moſes they were become wiſe men, magicians, &c.

(H) Hierophant imports a prieſt employed in explaining the doctrines, rites, &c. communicated to the initiated.

(I) See an excellent deſcription of theſe ſubterraneous abodes, and of the proceſs of probation carried on there, in a French romance, intitled *The Life of Sethos*.

and Elyſium, exhibited alternately and in quick ſucceſſion, muſt have made a deep and laſting impreſſion on the mind of the affrighted votary (K). Theſe ſcenes we ſhall deſcribe more fully in the ſequel.

19 The Grecian infernal regions copied from the Egyptian myſteries.

From the ſcenes exhibited in celebrating the Egyptian myſteries, eſpecially thoſe of Iſis and Oſiris, the Greeks ſeem to have copied their ideas of the infernal regions, and the ſubterraneous manſions of departed ſouls. Many colonies of Egyptians ſettled in Greece. From theſe the αοιδοι (L), or moſt early bards of Greece, learned them imperfectly. Of courſe, we find Homer's account of the infernal regions, and of the ſtate of departed ſouls, lame and incoherent. Succeeding bards obtained more full and more diſtinct information. Euripides and Ariſtophanes ſeem to have paved the way for the prince of Roman poets. Plato* and ſome of the other philoſophers have ſhown by their deſcriptions or alluſions, that the whole apparatus of Tartarus and Elyſium had become a hackneyed topic ſome centuries before Virgil was born. This incomparable poet borrowed his ideas from Homer, Ariſtophanes, Euripides, Plato, &c. Theſe, under his plaſtic hand, in the ſixth Æneid, grew into a ſyſtem beautiful, regular, uniform, and conſiſtent. The materials he has employed were created to his hand; he had only to collect, poliſh, arrange, and connect them.—The ſentiments collected from the Platonic philoſophy, and the inimitable epiſode copied from the annals of Rome, by the maſterly ſkill which he has diſplayed in the application of them, form the chief excellencies of the piece. For the reſt, he could well diſpenſe with going to Eleuſis (M): every old woman in Athens and Rome could repeat them.

* *Phædo.*

20 Myſteries brought from Egypt into Perſia and Greece.

Egypt was then the native land of myſteries as well as of idolatry. Every god and goddeſs reſpectively had their myſteries; but as thoſe of Iſis and Oſiris were the moſt celebrated, they of courſe became principal objects of purſuit as well as of imitation to the neighbouring nations. Theſe, as is generally believed, were carried into Perſia by Zoroaſtres, or Zorduſht, by whom they were conſecrated to Mithras. On theſe we ſhall make ſome obſervations in the ſequel.—Orpheus imported them into Thrace; Cadmus brought them into Boeotia, where they were ſacred to Bacchus. Inachus eſtabliſhed them at Argos in honour of Juno, the ſame with Iſis (N); Cyniras in Cyprus, where they were dedicated to Venus. In Phrygia they were ſacred to Cybele, the mother of the gods.

Our learned readers, who will probably reflect that the Egyptians were in ancient times inhoſpitable to ſtrangers, will perhaps be ſurpriſed that this faſtidious and jealous people were ſo ready to communicate the arcana of their religion to foreigners.—But they will pleaſe recollect, that a great part of Greece was planted with colonies from Egypt, Phœnicia, Paleſtine, &c. This we could eaſily prove, did the bounds preſcribed us admit ſuch a digreſſion. Orpheus, if not an Egyptian, was at leaſt of oriental extraction. Inachus, Cadmus, and Melampus, are univerſally allowed to have been Egyptians. Erechtheus, in whoſe reign the Eleuſinian myſteries were eſtabliſhed, was an Egyptian by birth, or at leaſt ſprung from Egyptian anceſtors. The Egyptians, then, in thoſe early ages, did not view the Greeks in the light of aliens, but as a people nearly related either to themſelves or the Phœnicians, who were their brethren. Upon this connection we imagine it was, that in later times moſt of the ſages of Greece, eſpecially of Athens, found ſo hoſpitable a reception among that people. They probably viewed them in the light of propagandi; apoſtles able and willing to diſſeminate their idolatrous rites. This obſervation, which might be ſupported by numberleſs authorities, did the nature of the preſent inquiry permit, will, we think, go a great way towards obviating the objection.

21 Myſteries of Mithras, Bacchus, and Ceres, the moſt auguſt.

Although, as has been obſerved, every particular deity had his own peculiar myſterious ſacred rites, yet of all others thoſe of Mithras, Bacchus (O), and Ceres, were deemed the moſt auguſt, and were moſt univerſally and moſt religiouſly celebrated. To theſe, therefore, we ſhall in a good meaſure confine ourſelves upon this occaſion. If our readers ſhall become intimately acquainted with theſe, they may readily diſpenſe with the knowledge of the reſt, which are, indeed, no more than ſtreams and emanations from theſe ſources. We ſhall then, in the firſt place, preſent to our readers a brief ſketch of the myſteries of Mithras.

MITHRAS, or, according to the Perſian, *Mihr*, was one of the great gods of the Aſiatics. His worſhip was for many ages confined to Perſia. Afterwards, however, it was propagated ſo far and wide, that ſome have imagined they had diſcovered veſtiges of it even in Gaul. *Mihr*, according to Dr Hyde*, ſignifies love, and likewiſe the *Sun*. If we might preſume to differ from ſo reſpectable an authority, we ſhould conjecture that it is a cognate of the Hebrew word *Muthir*, "excellentia, preſtantia." That there was an analogy between the Hebrew and old Perſian, is generally admitted by the learned. Be that as it may, Mithras was the ſun (P) among the Perſians; and in honour of

* *Relig. vet. Perſarum.*

(K) Perſons who had deſcended into Trophonius's vault were ſaid to have been ſo terrified with ſhocking ſights, that they never laughed during the remainder of their lives.

(L) Theſe were ſtrolling poets like our minſtrels, who frequented the houſes of the great men of Greece, and entertained the company upon public occaſions with ſinging and tales of other times.

(M) Biſhop Warburton has, with much ingenuity, and a vaſt profuſion of reading, endeavoured to prove that Virgil borrowed the whole ſcenery of the ſixth Æneid from the ſources mentioned in the text.

(N) Iſis was the moon, and the original Juno was the ſame planet.

(O) Bacchus was the Oſiris of the Egyptians, and Ceres was the Iſis of the ſame people.

(P) Moſheim, in his notes on Cudworth's Intellectual Syſtem, page 330, has taken much pains to prove that Mithras was a deified mortal; but we cannot agree with that learned man in this point.

22 Account of the myſteries of Mithras.

of that luminary this inſtitution was eſtabliſhed. Mithras, according to Plutarch (q), was the middle god between Oramaz and Ariman, the two ſupreme divinities of Perſia. But the fact is, the ſolar planet was the viſible emblem of Oramaz, the good genius of the Perſian tribes, and the ſame with the Oſiris of the Egyptians. From theſe people, ſome have imagined that Zoroaſtres (r), or Zerduſht, borrowed his myſteries of Mithras. To this opinion we cannot give our aſſent, becauſe the probationary trials to be undergone by the candidates among the former were much more ſavage and ſanguinary than among the latter.—Both, however, were inſtituted in honour of the ſame deity; and probably the ſcenes exhibited, and the information communicated in both, were analogous; a circumſtance which perhaps gave birth to the opinion above-mentioned.

The grand feſtival of Mithras was celebrated ſix days, in the middle of the month Mihr (s). Upon theſe days, it was lawful for the kings of Perſia to get drunk and dance. On this feſtival, we imagine, the candidates for initiation, having duly proved their vocation, were ſolemnly admitted to the participation of the myſteries.

Zoroaſtres (t) worſhipped Mithras, or the Sun, in a certain natural cave, which he formed into a temple, and filled up in a manner exactly mathematical. There Mithras was repreſented as preſiding over the lower world with all the pomp of royal magnificence. In it too were ſeen the ſymbols of Mithras and of the world, philoſophically and mathematically exhibited, to be contemplated and worſhipped. This deity was ſometimes repreſented as mounted on a bull, which he is breaking, and which he kills with a ſword. On ſome bas reliefs ſtill exiſting, he appears as a young man with his tiara turned upward, after the manner of the Perſian kings. He is clothed with a ſhort tunic and breeches, after the Perſian faſhion. Sometimes he wears a ſmall cloke. By his ſides are ſeen other human figures, with tiaras of the ſame faſhion on their heads, but without clokes. One of theſe figures commonly holds in his one hand a torch lifted up; in the other one turned downward. Sometimes over the cave is ſeen the chariots of the ſun and moon, and divers conſtellations, ſuch as cancer, ſcorpion, &c.

23 Probationary exerciſes previous to initiation.

In one of thoſe caves the ceremonies of initiation were performed; but before the candidate could be admitted, he was forced to undergo a courſe of probationary exerciſes, ſo numerous and ſo rigorous, that very few had courage and fortitude enough to go thro' them. He was obliged to live a life of virtue and abſtinence for a ſpace of ſeven years previous to the period of his initiation. Some months before it, he was obliged to ſubmit to a long and auſtere faſt, which continued fifty days. He was to retire ſeveral days to a deep and dark dungeon, where he was ſucceſſively expoſed to all the extremes of heat and cold. Meantime he frequently underwent the baſtinado, which the prieſts applied without mercy. Some ſay this fuſtigation continued two whole days, and was repeated no leſs than 15 times. In the courſe of theſe probationary exerciſes, the candidate was generally reduced to a ſkeleton; and we are told, that there have been ſeveral inſtances of perſons who have periſhed in the attempt.

Upon the eve of the initiation, the aſpirant was obliged to * brace on his armour, in order to encounter giants and ſavage monſters. In thoſe ſpacious ſubterraneous manſions a mock hunting was exhibited. The prieſts and all the ſubordinate officers of the temple, transformed into lions, tygers, leopards, boars, wolves, and other ſavage creatures, aſſailed him with loud howlings, roaring, and yelling, and every inſtance of ferine fury. In thoſe mock combats, the hero was often in danger of being really worried, and always came off with bruiſes and wounds. Lampridius informs us, that when the emperor Commodus was initiated, he actually carried the joke too far, and butchered one of the prieſts who attacked him in the figure of a wild beaſt. The Perſians worſhipped Mithras or the Sun by a perpetual fire: hence the votary was obliged to undergo a fiery trial; that is, to paſs ſeven times through the ſacred fire, and each time to plunge himſelf into cold water. Some have made theſe probationary penances amount to 80; others have thought that they were in all only 8. As we find no good authority for either of theſe numbers, we think ourſelves at liberty to hazard the following conjecture: The number *ſeven* was deemed ſacred over all the eaſt. The Mythriac penances we imagine were either ſeven, or if they exceeded it, were regulated by ſeven repetitions of that number. The candidate having undergone all theſe torturing trials with becoming patience and fortitude, was declared a proper ſubject for initiation. But before his admiſſion he was obliged to bind himſelf by the moſt ſolemn oath, with horrible imprecations annexed, never to divulge any ſingle article of all that ſhould be communicated to him in the courſe of his initiation.

* *Jul. Firmicus.*

24 Oath of ſecrecy.

25 Revelations in the myſteries of Mithras.

What ἀπορρητα or *ineffable ſecrets* were imparted to the initiated, it is impoſſible at this diſtance of time to diſcover with any tolerable degree of certainty. We may, however, reſt aſſured, that the moſt authentic tradition concerning the origin of the univerſe; the nature, attributes, perfections, and operations, of Oromaſd; the baleful influences of Ariman; and the benign

(q) Iſis and Oſiris, page 369 l. 20, from the bottom. This philoſopher makes Zoroaſter, according to ſome, 5000 years prior to the Trojan war. This date is certainly extravagant. We cannot, however, agree with ſome moderns, who make him contemporary with Darius Hyſtaſpes, the immediate ſucceſſor of Cambyſes, becauſe it contradicts all antiquity.

(r) M. Silohwette, Differ. V. page 17. aſſerts that Zoroaſtres was initiated among the Egyptians.

(s) The month Mihr began September 30, and ended October 30.

(t) See Dr Hyde de Rel vet. Perſ. page 16, 17. Mr Bryant's Anal. vol. i. page 232. Porphyr. de antro Nymph, page 254. This philoſopher often mentions the cave of Mithras, and always attributes the inſtitution of his rites to Zoroaſter

nign effects of the government of Mithras, were unfolded and inculcated. The secret phenomena of nature, as far as they had been discovered by the magi, were likewise exhibited; and the application of their effects, to astonish and delude the vulgar, were taught both in theory and practice. The exercise of public and private virtues was warmly recommended; and vice represented in the most odious and frightful colours. Both these injunctions were, we may suppose, enforced by a display of the pleasures of Elysium and the pains of Tartarus, as has been observed above in describing the mysteries of the Egyptians.

Those initiations are mentioned by Lampridius in the life of Commodus, and likewise by Justin * and Tertullian ‡, who both flourished in the second century. The last of these two speaks of a kind of baptism, which washed from the souls of the initiated all the stains which they had contracted during the course of their lives prior to their initiation. He at the same time mentions a particular mark which was imprinted upon them (u), of an offering of bread, and an emblem of the resurrection; which particulars, however, he does not describe in detail. In that offering, which was accompanied with a certain form of prayer, a vessel of water was offered up with the bread. The same father elsewhere inform us, that there was presented to the initiated a crown suspended on the point of a sword; but that they were taught to say, *Mithras is my crown.* By this answer was intimated, that they looked upon the service of that deity as their chief honour and ornament.

* *Dial. cum Tryphone.*
‡ *De præscript. adver. Hæret.*

After that the Teletæ (x) were finished, the pupil was brought out of the cave or temple, and with great solemnity proclaimed a lion of Mithras (y); a title which imported strength and intrepid courage in the service of the deity. They were now consecrated to the god, and were supposed to be under his immediate protection; an idea which of course animated them to the most daring and dangerous enterprises.

The worship of Mithras was introduced into the Roman empire towards the end of the republic, where it made very rapid progress. When Christianity began to make a figure in the empire, the champions for paganism thought of proposing to men the worship of this *power of benevolence*, in order to counterbalance or annihilate that worship which the Christians paid to Jesus Christ the true *Sun* of righteousness. But this mode was soon abolished, together with the other rites of paganism. The Persian grandees often affected names compounded with Mithras; hence Mithridates, Mithrobarzanes, &c.: Hence, too, the precious stone called *Mithridat* *, which by the reflexion of the sun sparkled with a variety of colours. There is likewise a certain pearl of many different colours, which they call *Mithras*. It is found among the mountains near the Red Sea; and when exposed to the sun, it sparkles with a variety of dyes. We find likewise a king of Egypt of that name who reigned at Heliopolis; who being commanded in a dream to erect an obelisk to the solar deity, reared a most prodigious one in the neighbourhood of that city.

* *Solinus*, cap. 10.

The votaries of Mithras pretended that he was sprung from a rock, and that therefore the place where the mysterious ceremonies were communicated to the initiated was always a cave. Many different reasons have been assigned for the origin of this rock-born deity, most of which appear to us unsatisfactory. If our readers will be obliging enough to accept of a simple and obvious conjecture, they may take the following: A rock is the symbol of strength and stability (z): the dominion of Mithras, in the opinion of his votaries, was firm as a rock, and stable as the everlasting hills. If our readers should not admit the probability of this conjecture, we would beg leave to remit them to the learned Mr Bryant's *Analysis of Mythology*, where they will find this point discussed with deep research and wonderful ingenuity. Whatever may have been the origin of this opinion with relation to the birth of Mithras, it is certain that some reverence to rocks and caves was kept up a long time even after the establishment of Christianity. Hence the prohibition given to some of the proselytes to that religion, that they should no more presume to offer up their prayers *ad petras* at the rocks (a).

26 Mithras said to have sprung from a rock.

We shall conclude our account of the mysteries of Mithras with a passage from Mr Anquetil, to whom we are so much indebted for what knowledge we have of the Persian theology, and in which the functions of that deity are briefly and comprehensively delineated. "The peculiar functions of Mithras are to fight continually against Abriman and the impure army of evil genii, whose constant employment is to scatter terror and desolation over the universe; to protect the frame of nature from the demons and their productions. For this purpose he is furnished with a thousand ears and a thousand eyes, and traverses the space between heaven and

 earth,

(u) In allusion to this practice of imprinting a sacred mark, probably on the forehead of the initiated, we find the injunction to the angel, Ezek. chap. ix. ver. 4. and the Revelation *passim*.

(x) The mysteries were called *Teletæ*, which imports, "the rites which confer perfection."

(y) *Tertull. adv. marc.* p. 55. The priests of Mithras were called the *lions of Mithras*, and his priestesses *lionesses*; some say *hyænas*. The other inferior ministers were called *eagles*, *hawks*, *ravens*, &c. and on their festivals they wore masks corresponding to their titles, after the Egyptian manner, where the priests appeared at the ceremonies with masks resembling the heads of lions, apes, dogs, &c. a circumstance which furnishes a presumption that the mysteries of Mithras were of Egyptian original.

(z) Our Saviour probably alludes to this emblem, when he talks of *building his church on a rock;* and adds, *that the gates of hell should not prevail against it.*

(a) The Caledonian druids seem to have regarded certain stones with a superstitious veneration, in which the Catholics imitated them. There are in several places of Scotland large stones, which the vulgar call *lecre* stones, *i. e.* we imagine, *lecture.*

earth, his hands armed with a club or mace. Mithras gives to the earth light and sun: he traces a course for the waters: he gives to men corn, pastures, and children: to the world virtuous kings and warriors; maintains harmony upon earth, watches over the law, &c." As the history of Mithras, and the nature of his mysteries, are not generally known, we imagined it would be agreeable to many of our readers to have the most important articles relating to that subject laid before them as it were in detail.

27 Mysteries of Bacchus.

We now proceed to the orgia, or mysteries of Bacchus, which we shall introduce with a brief history of that deity. The original Dionysus or Bacchus was the Osiris of the Egyptians, which last was the Sun (B). Whether there was an Egyptian monarch of that name, as Diodorus Siculus affirms §, has no manner of connection with the present disquisition. The Greek name of that deity is plainly oriental, being compounded of *di*, "bright;" and *nasia* or *nasa*, in the Æolic dialect *nusa*, "a prince." This name was imported from the east by Orpheus, Cadmus, or by whoever else communicated the worship of Osiris to the Greeks. That the Dionysus of the Greeks was the same with the Osiris of the Egyptians, is universally allowed. Herodotus tells us expressly *, that *Osiris* is *Dionysus* in the Greek language: Martianus Capellus, quoted above, expresses the very same idea ‖. The original Osiris was then the sun; but the Dionysus or Bacchus of the Greeks was the same with the Osiris of the Egyptians; therefore the Bacchus or Dionysus of the Greeks was likewise the same luminary.

§ *Lib.* 1.

28 Bacchus the same with Osiris.

* *Lib.* 2. *cap.* 144.

‖ *Theol. Egyp. lib.* 2. *cap* 1.

The name *Osiris* has much embarrassed critics and etymologists. The learned Jablonski ‡, instead of delineating the character, attributes, operations, adventures, exploits, and peculiar department assigned this deity by his votaries, has spent much of his pains on trying to investigate the etymology of his name. If it is granted, which is highly probable, that the Hebrew and Egyptian tongues are cognate dialects, we should imagine that it is actually the *Chosher* or *Oshir* of the former language, which imports, "to make rich, to become rich." Indeed the words *Osiris* and *Isis* were not the vulgar names of the sun and moon among the Egyptians, but only epithets importing their qualities. The name of the sun among that people was *Phri* or *Phry*, and that of the moon *Ioh*, whence the Greek *Io*. The term *Osiris* was applied both to the sun and to the river Nile; both which by their influence contributed respectively to enrich and fertilize the land of Egypt.

‡ *Pantb. Egyp.*

It was a general custom among the orientals to denominate their princes and great men from their gods, demigods, heroes, &c. When the former were advanced to divine honours, they were in process of time confounded with their archetypes. The original divinities were forgotten, and these upstart deities usurped their place and prerogatives. In the earliest periods of the Egyptian monarchy, there appeared two illustrious personages, Osiris and Isis. These were the children of Cronus; and being brother and sister, they were joined in matrimony, according to the custom of the Egyptians. As the brother and husband had assumed the name of the *Sun*, so the sister and consort took that of *Isis*, that is, "the woman *," a name which the Egyptians applied both to the moon and to the earth, in consequence of the similarity of their nature, their mutual sympathy, and congenial fecundity. Osiris having left his consort Isis regent of the kingdom, with Hermes as her prime minister, and Hercules as general of her armies, quitted Egypt with a numerous body of troops, attended by companies of fauns (C), satyrs, singing women, musicians, &c. traversed all Asia to the eastern ocean. He then returned homeward through the Upper Asia, Thrace, Pontus, Asia Minor, Syria, and Palestine. Wherever he marched, he conferred numberless benefits on the savage inhabitants. He taught the art of cultivating the ground, preserving the fruits of the earth, and distinguishing the wholesome and nutritive from the unwholesome and poisonous. He instructed them in the culture of the vine; and where vines could not be produced, he communicated to them the method of producing a fermented liquor from barley, very little inferior to wine itself. He built many cities in different parts of the globe, planted numerous colonies (D), and wherever he directed his course instituted just and wholesome laws, and established the rites and ceremonies of religion, and left priests and catechists of his train to teach and inculcate the observance of them. In short, he left every where lasting monuments of his progress, and at the same time of his generosity and beneficence. Where he found the people docile and submissive, he treated them with kindness and humanity: if any showed themselves obstinate, he compelled them to submit to his institutions by force of arms.

* *Herapol'o, cap.* 3.

29 Exploits of Osiris.

At the end of three years, he returned to Egypt, where his brother Typhon, a wicked unnatural monster, had been forming a conspiracy against his life. This traiterous design he soon after accomplished in the following manner: He invited Osiris, with some other persons whom he had gained over, to an entertainment. When the repast was finished, he produced a beautiful coffer, highly finished, and adorned with studs of gold; promising to bestow it on the person whom it should fit best. Osiris was tempted to make the experiment. The conspirators nailed down the cover upon him, and threw the coffer into the river. This coffer, which was now become the coffin of Osiris, was, they tell us, wafted by the winds and waves to the neighbourhood of Byblus, a city of Phœnicia, where it was cast on shore, and left by the waves at the foot of a tamarind tree.

30 His death.

Isis, in the mean time, disconsolate and forlorn, attended

(B) See Macrob. lib. i. cap. 21. p. 247. bottom. Diogenes Laert. in proœmio, par. 10. Martian. Capel. Lib. 2 Jablonski, vol. i lib. ii. p. 415. par. 3. Plut. Isis Osir. *passim*.

(C) Men and women dressed in the habits of those rural deities.

(D) Many have thought this expedition fabulous; but the numberless monuments of Egyptian architecture, sculpture, statuary, lately discovered in the east, confirm it.

31 Wanderings of Iſis in ſearch of his body.

tended by Anubis, was ranſacking every quarter in ſearch of her beloved Oſiris. At length being informed by her faithful attendant and guardian, that his body was lodged ſomewhere in the neighbourhood of Byblus, ſhe repaired to that city. There, they ſay, ſhe was introduced to the queen, and after (E) a variety of adventures ſhe recovered the corpſe of her huſband, which, of courſe, ſhe carried back with her to Egypt: but the miſchievous Typhon, ever on the watch, found her on the banks of the Nile; and having robbed her of her charge, cut the body into 14 parts, and ſcattered them up and down. Now, once more, according to the fable, Iſis ſet out in queſt of thoſe parts, all of which, only one excepted, ſhe found, and interred in the place where ſhe found them; and hence the many tombs of Oſiris in that country. Theſe tombs were denominated *topoſins* by the natives. Many other fabulous adventures were aſcribed to thoſe two perſonages, which it is not our province to enumerate at preſent. If our readers ſhould wiſh to be more minutely informed on this ſubject, they may have recourſe to the authors mentioned in the laſt-quoted author, or to the learned Mr Bryant's Analyſis of Ancient Mythology, and M. Cour de Gebelin, where they will find matter enough to gratify their curioſity.

32 The myſteries of Iſis and Oſiris inſtituted in commemoration of thoſe adventures.

To commemorate thoſe adventures, the myſteries of Iſis and Oſiris were inſtituted; and from them both thoſe of Bacchus and Ceres, among the Greeks, were derived. Of the Egyptian ſolemnity, we have an exact epitome in one of the fathers of the church to the following purpoſe: "Here follows (ſays he) an epitome of the myſteries of Iſis and Oſiris. They deplore annually, with deep lamentations and ſhaved heads, the cataſtrophe of Oſiris over a buried ſtatue of that monarch. They beat their breaſts, mangle their arms, tear open the ſcars of their former wounds; that by annual lamentations the cataſtrophe of his miſerable and fatal death may be revived in their minds. When they have practiſed theſe things a certain number of days, then they pretend that they have found the remains of his mangled body; and having found them, their ſorrows are lulled aſleep, and they break out into immoderate joy." What maxims of morality, ſecrets of phyſiology, or phenomena of aſtronomy, were couched under this allegorical proceſs, is not our buſineſs to inveſtigate in this place. We ſhall only obſerve, that, in all probability, Oſiris and Iſis were ſovereigns of Egypt at a very early period; that they had conferred many ſignal benefits on their ſubjects, who, influenced by a ſenſe of gratitude, paid them divine honours after their deceaſe; that in proceſs of time they were confounded with the ſun and the moon; and that their adventures were at length magnified beyond all credibility, interlarded with fables, and allegories, and employed in the myſteries as channels to convey a variety of inſtructions to the initiated.

33 Transferred to Byblus and Tyre, where Oſiris was called *Adonis* and *Bacchus*;

Be that as it may, it is certain that the very ſame mode of worſhip was eſtabliſhed at Byblus, and in after ages transferred to Tyre. The Mizraim and Chanaanim were nearly connected by blood, and their religious ceremonies were derived from the very ſame ſource. By what medium the worſhip of Oſiris at Abydus and Tyre was connected, we ſhall leave to others to explain; we ſhall only obſerve, that among the Phœnicians this deity obtained the names *Adonis* and *Bacchus*. The former is rather an (F) epithet than a name: the latter is evidently an alluſion to the weeping and lamentation (G) with which the rites were performed. We find another name of that divinity mentioned in Scripture (H); but that term is plainly of Egyptian original: we ſhall now proceed to the myſteries of Oſiris as they were celebrated among the Greeks and Thracians, under the name of the *Orgia of Dionyſus* or *Bacchus* *.

* *Diod. Sicul. Voſſius de Idol.*

Orpheus the celebrated Thracian philoſopher had travelled into Egypt in queſt of knowledge; and from that country, according to the moſt authentic accounts, he imported the bacchanalian rites and inſtitutions. Some have affirmed that this ſame Orpheus being intimately acquainted with the family of Cadmus, communicated theſe rites to them, and endeavoured to transfer them to the grandſon of that hero, which grandſon became afterwards the Grecian Bacchus. It is, however, we think, much more probable, that thoſe rites were imported from Egypt or Phœnicia, by (I) Cadmus himſelf, who was a native of the former country, and is thought to have ſpent ſome time in the latter, before he emigrated in queſt of a ſettlement in Boeotia. It is ſaid that Semele, the daughter of Cadmus, and the mother of the Grecian Bacchus, was ſtruck with lightning at the very inſtant of his birth. The child was, in all probability, denominated *Bacchus* (K), from the ſorrow and lamentation this melancholy accident had occaſioned in the family. Cadmus, in order to conceal the diſhonour of his daughter, might, we imagine, convey away his infant grandſon to ſome of his relations in Phœnicia

34 And thence imported by Cadmus into Boeotia.

or

(E) For the conqueſts and adventures of Oſiris and Iſis, we muſt ſend our learned readers to Diod. Sic. Bibli, l. i. and Plut. Iſis and Oſiris, p. 256. et ſeq. which we have been obliged to abridge, in conſequence of the narrow limits preſcribed us.

(F) Adonis is evidently the Hebrew *Adoni*, "my lord," and imports the ſovereignty of the deity.

(G) Bacchus is derived from the Phœnician word *bahah*, "to weep." This was the name embraced by the Romans.

(H) Ezek. chap. 8. ver. 14. *tammuz* is the name of one of the months of the Egyptian year.

(I) Cadmus and Melampus, who were both Egyptians, introduced the Bacchanalia into Greece. The Egyptian or oriental name of Bacchus was *Dinuſi*, that is "the prince of light." Cadmus had learned the name *Bacchus* from the Phœnicians.

(K) We have omitted the immenſe farrago of fable relating to the connection between Jupiter and Semele, as of little importance to our readers.

or Egypt. There he was educated and inſtructed in all the myſteries of Iſis and Oſiris, and at the ſame time initiated in all the magical or juggling tricks of the Egyptian prieſts and Hierophants. Thus accompliſhed, when he arrived at manhood he returned to Thebes with the traditional retinue of the original deity of the ſame name; and claimed divine honours accordingly. This claim, however, was not admitted without much oppoſition; Pentheus, another grandſon of Cadmus, was torn to pieces by the frantic Bacchanalians upon mount Citheron, becauſe he attempted to interrupt them in celebrating the orgia. Some have thought that Cadmus loſt his kingdom for the ſame reaſon; but this we think is by no means probable: we ſhould rather imagine that the old prince was privy to the whole proceſs, and that it was originally planned by him, with a view to attract the veneration of his new ſubjects, by making them believe that there was a divinity in his family.

35 The actions of Oſiris attributed to the Grecian Bacchus.

Be that as it may, the vain-glorious Greeks attributed all the actions of the Egyptian hero to their new Bacchus: and according to their laudable practice, engaged him in numberleſs adventures in which his prototype had no ſhare. Moſt of thoſe are futile and unintertaining (L). The Greeks commonly adopted ſome oriental perſonage as the hero of their mythological rhapſodies. Him they naturaliſed and adopted into ſome Grecian family, and ſo he became their own. To him they aſcribed all the adventures and exploits of the oriental archetype from whom he was copied. Conſequently in the orgia (M), every thing was collected that had been imported from the eaſt relating to Oſiris; and to that farrago was joined all that the Grecian rhapſodiſts had thought fit to invent in order to amuſe the credulous multitude. This, however, was not the whole of the misfortune: The adventures of Oſiris were deſcribed by the Egyptian Hierophants, veiled with allegorical and hieroglyphical myſteries. Theſe the perſons who imported them into Greece did not thoroughly comprehend, or if they did, they were not inclined to communicate them ſound and unſophiſticated. Beſides, many oriental terms were retained, the import of which was in proceſs of time loſt or diſtorted. Hence the religious ceremonies of the Greeks became a medley of inconſiſtencies. The myſteries of Bacchus, in particular, were deeply tinctured with this meritricious colouring; the adventures of the Theban pretender were grafted upon thoſe of the Egyptian archetype, and out of this combination was formed a tiſſue of adventures diſgraceful to human nature, abſurd, and inconſiſtent. Indeed the younger or Theban Bacchus ſeems to have been a monſter of debauchery; whereas the Egyptian is repreſented as a perſon of an oppoſite character. Of courſe the myſteries of the former were attended with the moſt ſhocking abominations.

36 Myſteries of Bacchus ſpread into Greece, &c.

Theſe myſteries, as has been obſerved above, were firſt celebrated at Thebes the capital of Bœotia, under the auſpices of the family of Cadmus. From this country they gradually found their way into Greece, and all the neighbouring parts of Europe. They were celebrated once every three years (N), becauſe at the end of three years Oſiris returned from his Indian expedition. As the Greeks had impudently transferred the actions of the Egyptian hero to their upſtart divinity, the ſame period of time was obſerved for the celebration of thoſe rites in Greece that had been ordained for the ſame purpoſe in Egypt.

37 Proceſs of their celebration.

When the day appointed for the celebration of the orgia (O) approached, the prieſts iſſued a proclamation, enjoining all the initiated to equip themſelves according to the ritual, and attend the proceſſion on the day appointed. The votaries were to dreſs themſelves in coats of deer-ſkins, to looſe the fillets of their hair, to cover their legs with the ſame ſtuff with their coats, and to arm themſelves with thyrſi, which were a kind of ſpears wholly of wood entwined with leaves and twigs of the vine or ivy. It is ſaid that the Bachanalians, eſpecially the Thracians, uſed often to quarrel and commit murder in their drunken revels; and that in order to prevent thoſe unlucky accidents, a law was enacted, that the votaries inſtead of real ſpears ſhould arm themſelves with thoſe ſham weapons which were comparatively inoffenſive. The ſtatue of the deity, which was always covered with vine or ivy leaves, was now taken down from its pedeſtal, and elevated on the ſhoulders of the prieſts. The cavalcade then proceeded nearly in the following manner:

Firſt of all, hymns were chanted in honour of Bacchus, who was called the *Power of dances, ſmiles, and jeſts*; while at the ſame time he was deemed equally qualified for the exploits of war and heroiſm. Horace, in ſome of his dithyrambic odes, has conciſely pointed out the ſubjects of thoſe Bacchanalian ſongs. In the collection of hymns fabulouſly attributed to Orpheus, we find ſeveral addreſſed to this deity (P), each

(L) Nonnus, an Egyptian of Pentapolis, has collected all the fabulous adventures of Bacchus, and exhibited them in a beautiful but irregular poem: To this we muſt refer our learned readers. Of the Dionyſiacs we have a moſt judicious ſketch, *Geblin. Calend.* p. 553. et ſeq.

(M) The orgia belonged to all the Mydones, but to thoſe of Bacchus in a peculiar manner.

(N) Hence theſe origia were called *Triteria*.

(O) According to Clem. Alexand. Cohort. pag. 12. Pott. the word *orgia* is derived from *orge*, which ſignifies "anger," and originated from the reſentment of Ceres againſt Jupiter, in conſequence of a moſt outrageous inſult he had offered her with ſucceſs. We ſhould rather imagine it derived from the Hebrew word *argoz*, ſignifying a "cheſt or coffer," alluding to the caſket which contained the ſacred ſymbols of the god.—The Egyptians or Phœnicians might write and pronounce, argoz, *orgoz*, or in ſome manner nearly reſembling *orgia*.

(P) Theſe ſtand between the 41 and 52; one to Lenæus, or the preſſer; one to Libnites, or the winnower; one to Beſſareus, or the vintager; one to Sabazius the god of reſt; to Myſes, or the Mediator, &c.

each under a different title, derived from the different appellations of the god. All these names are of oriental original, and might easily be explained, did the bounds prescribed us admit of etymological disquisitions.

The hymn being finished, the first division of the votaries proceeded, carrying a pitcher of wine, with a bunch of the vine. Then followed the he-goat; an animal odious to Bacchus, because he ravages the vines. The chanting the hymns, the sacrificing the he-goat, and the revels, games, and diversions, with which the celebration of those rites was attended, gave birth to the dramatic poetry of the Greeks; as the persons habited in the dress of Fauns, Sylvans, and Satyrs (Q), furnished the name of another species of poetry of a more coarse and forbidding aspect.

38 The mysterious coffer, with its contents.

Then appeared the mysterious coffer or basket, containing the secret symbols of the deity. These were the phallus (R), some grains of sesama, heads of poppies, pomegranates, dry figs, cakes baked of the meal of different kinds of corn, salt, carded wool, rolls of honey, and cheese; a child, a serpent (S), and a fan (T). Such was the furniture of the sacred coffer carried in the solemn Bacchanalian procession. The inventory given by some of the fathers ‡ of the church is somewhat different. They mention the dye, the ball, the top, the wheel, the apples, the looking-glass, and the fleece. The articles first mentioned seem to have been of Egyptian original; the last were certainly superinduced by the Greeks, in allusion to his being murdered and torn in pieces when he was a child by the machinations of Juno, who prevailed with the Titans to commit the horrid deed. These last seem to have been memorials of his boyish play-things; for, says Maternus, "the Cretans §, in celebrating the rites of the child Bacchus, acted every thing that the dying boy either said, or did, or suffered. They likewise (says he) tore a live bull in pieces with their teeth, in order to commemorate the dismembering of the boy." For our part, we think, that if such a beastly rite was practised, it was done in commemoration of the savage manner of life which had prevailed among men prior to the more humane diet invented and introduced by Isis and Osiris. Be that as it may, we learn from Porphyry *, that in the island of Chios they used to sacrifice a man to Bacchus, and that they used to mangle and tear him limb from limb. This was no doubt practised in commemoration of the catastrophe mentioned above.

‡ *Clem. Alexand.*

§ *De Errore Prof. Gent.*

39 Human sacrifices.

* *De Abstinentia.*

The orgia of this Pagan god were originally simple enough; but this unsophisticated mode was of no long continuance, for riches soon introduced luxury, which quickly infected even the ceremonies of religion. On the day set apart for this solemnity, men and women crowned with ivy, their hair dishevelled, and their bodies almost naked, ran about the streets, roaring aloud *Evohe* (U) Bacche. In this rout were to be seen people intoxicated at once with wine and enthusiasm, dressed like Satyrs, Fans, and Silenuses, in such scandalous postures and attitudes, with so little regard to modesty and even common decency, that we are persuaded our readers will readily enough forgive our omitting to describe them. Next followed a company mounted upon asses, attended by Fawns, Bacchanals, Thyades, Mimallonides, Naiads, Tityri, &c. who made the adjacent places echo to their frantic shrieks and howlings. After this tumultuous herd were carried the statues of victory and altars in form of vine-sets crowned with ivy, smoking with incense and other aromatics. Then appeared several chariots loaded with thyrsi, arms, garlands, casks, pitchers, and other vases, tripods, and vans. The chariots were followed by young virgins of quality, who carried the baskets and little boxes, which in general contained the mysterious articles above enumerated. These, from their office, were called *cistophoræ*. The phallophori (X) followed them, with a chorus of Itophallophori habited like Fauns, counterfeiting drunk persons, singing in honour of Bacchus songs and catches suited to the occasion. The procession was closed by a troop of Bacchanalians crowned with ivy, interwoven with branches of yew and with serpents *. Upon some occasions, at those scandalous festivals, naked women whipped themselves, and tore their skin in a most barbarous manner. The procession terminated on mount Citheron, when it set out from Thebes; and in other places, in some distant unfrequented desert, where the votaries practised every species of debauchery with secrecy.

40 Total contempt of decency.

* *Ovid. Met.*

(Q) Dacier, Casaubon, and other French critics, have puzzled and perplexed themselves to little purpose about the origin of this word, without considering that it was coeval to dramatic poetry.

(R) The phallus was highly respected by the Egyptians, and was used as the emblem of the fecundity of the human race.

(S) That reptile was in high veneration among the Egyptians. See Euseb. Præp. Evang. l. i. pag. 26. Steph. where we have a minute detail of the symbolical properties of that creature, according to Taautos the great legislator of that people.

(T) Servius in Georg. I. Virg. ver. 166. Mystica *vanus* Jacchi. The fan, says he, is an emblem of that purifying influence of the mysteries by which the initiated were cleansed from all their former pollutions, and qualified for commencing a holy course of life.

(U) Clem. Alexand. Cohort. pag. 11. Pott. derives this word from *Cheveh*, the mother of mankind, who first opened the gate to that and every other error; but we are rather inclined to believe that it comes from the oriental word *Hevé*, which signifies a "serpent;" which among the Egyptians was sacred to the sun, and was likewise the emblem of life and immortality. It then imported a prayer to Bacchus for life, vigour, health, and every other blessing.

(X) The phallus was the symbol of the fructifying power of Nature. The Itophallus was the type of that power in act.

crecy and impunity. Orpheus ſaw the degeneracy of thoſe ceremonies; and in endeavouring to reform them he probably loſt his life. Pentheus ſuffered in the like attempt, being torn in pieces by the Bacchanalians on mount Citheron, among whom were his own mother and his aunts. The Greeks, who were an airy jovial people, ſeem to have paid little regard to the plaintive part of the orgia; or rather, we believe, they acted with howling and frantic exclamations, often enhanced by a combination of drunkenneſs, ecſtaſy, and enthuſiaſtic fury.

41 Doctrines inculcated in the orgia.

What ſecrets, religious, moral, political, or phyſical, were communicated to the votaries, it is impoſſible to determine with any degree of certainty.—One thing we may admit, namely, that the doctrines diſcovered and inculcated in the orgia, were originally the very ſame which the apoſtles of the ſect had imbibed in Egypt and Phœnicia; and of which we have given a brief account near the beginning of this article. It is, however, probable, that the ſpurious or Theban Bacchus had ſuperadded a great deal of his own invention, which, we may believe, was not altogether ſo ſound and ſalubrious as the original doctrine. However that may be, the initiated were made to believe that they were to derive wonderful advantages ‡ from the participation of thoſe rites, both in this life and that which is to come. Of this, however, we ſhall talk more at length by and by in our account of the Eleuſinian myſteries.

To detail the etymology of the names of this Pagan deity, the fables relating to his birth, his education, his transformations, his wars, peregrinations, adventures, the various and multiform rites with which he was worſhipped, would ſwell this article to a moſt immoderate ſize. If any of our readers ſhould wiſh to be more minutely and more accurately acquainted with this ſubject, we muſt beg leave to remit them to Diod. Sic. Apollod. Bibl. Euripid. Bacchæ. Ariſtophane Ranæ, Nonn Dionyſ. and among the moderns, to Ban. Mythol. Voſſ. de origi. Idol. Monſ. Fourmont, Reflexions ſur l'origine anciens peuples, Mr Bryant's Analyſ. and eſpecially to Mons Cour de Gebelin, Calendries ou Almanach. That prince of etymologiſts, in his account of the feſtival of Bacchus, has given a moſt acute and ingenious explication of the names and epithets of that deity. For our part, we have endeavoured to collect and exhibit ſuch as we judged moſt important, moſt entertaining, and moſt inſtructive, to the leſs enlightened claſſes of our readers.

42 Eleuſinian myſteries inſtituted in honour of Ceres.

We now proceed to the Eleuſinian myſteries, which, among the ancient Greeks and Romans, were treated with a ſuperior degree of awe and veneration. Theſe were inſtituted in honour of Ceres, the goddeſs of corn; who, according to the moſt authentic accounts, was the Iſis of the Egyptians. The myſteries of Oſiris and Iſis have been hinted at in the preceding part of this article. They were originally inſtituted in honour of the ſun and moon, and afterwards conſecrated to an Egyptian prince and princeſs; who, in conſequence of their merits, had been deified by that people. We know of no more exact and brilliant deſcription of the ceremonies of that goddeſs, in the moſt poliſhed ages of the Egyptian ſuperſtition, than what we meet with in the witty and florid Apuleius *, to which we muſt take the liberty to refer our more curious readers. Our buſineſs at preſent ſhall be to try to inveſtigate by what means, and upon what occaſion, thoſe myſteries were introduced into Attica, and eſtabliſhed at Eleuſis. A paſſage from Diodorus Siculus §, which we ſhall here tranſlate, will, we think, throw no inconſiderable light on that abſtruſe part of the ſubject.

* *Lib.* 11.

§ *Lib.* I.

43 On what occaſion introduced into Attica.

"In like manner with him (Cecrops), ſays that judicious hiſtorian, they tell us, that Erectheus, a prince of Egyptian extraction, once reigned at Athens. Of this fact they produce the following evidence: A ſcorching drought, during the reign of this prince, prevailed over almoſt all the habitable world, except Egypt; which, in conſequence of the humidity of its ſoil, was not affected by that calamity. The fruits of the earth were burnt up; and at the ſame time multitudes of people periſhed by famine. Erectheus, upon this occaſion, as he was connected with Egypt, imported a vaſt quantity of grain from that country to Athens. The people, who had been relieved by his munificence, unanimouſly elected him king. Being inveſted with the government, he taught his ſubjects the myſteries of Ceres at Eleuſis and the mode of celebrating the ſacred ceremonies, having tranferred from Egypt the ritual for that purpoſe. In thoſe times the goddeſs is ſaid to have made her appearance at Athens three ſeveral times; becauſe, according to tradition, the fruits of the earth which bear her name were then imported into Attica. On this account the ſeeds and fruits of the earth were ſaid to be the invention of that deity. Now the Athenians themſelves acknowledge, that, in the reign of Erecthens, the fruits of the earth having periſhed for want of rain, the arrival of Ceres in their country did actually happen, and that along with her the bleſſing of corn was reſtored to the earth. They tell us at the ſame time, that the teletæ and the myſteries of that goddeſs were then received and inſtituted at Eleuſis."

Here then we have the whole myſtery of the arrival of Ceres in Attica, and the inſtitution of her myſteries at Eleuſis unveiled. The whole is evidently an oriental allegory. The fruits of the earth had been deſtroyed by a long courſe of drought: Egypt, by its peculiar ſituation, had been preſerved from that dreadful calamity. Erectheus, in conſequence of his relation to the Egyptians, imported from their country a quantity of grain, not only ſufficient for the conſumption of his own ſubjects, but alſo a great overplus to export to other parts of Greece, Sicily, Italy, Spain, &c. Triptolemus, another Egyptian, was appointed by Erectheus to export this ſuperfluous ſtore. That hero, according to Pherecydes, was the ſon of Oceanus and Tellus, that is, of the ſea and the earth; becauſe his parents were not known, and becauſe he came to Eleuſis by ſea. The ſhip in which he ſailed, when he diſtributed his corn to the weſtern parts of the world, was decorated with the figure of a winged dragon: therefore, in the allegorical ſtyle of his country, he was ſaid to be wafted through the air in a chariot drawn by dragons. Thoſe creatures, every body knows, were held ſacred by the Egyptians.

Wherever Triptolemus diſpoſed of his corn, thither were extended the wanderings of Ceres. In order to elucidate

elucidate this point, we muſt obſerve, that along with the grain imported from Egypt, Erectheus, or Triptolemus, or both, tranſported into Attica a cargo of prieſts and prieſteſſes from the temples of Buſiris, a city which lay in the § centre of the Delta, where the goddeſs Iſis had a number of chapels erected for her worſhip. The preſidents of theſe ceremonies, like all other bigots, gladly laid hold on this opportunity of propagating their religious rites, and diſſeminating the worſhip of the deities of their country. That the Egyptian prieſts were zealous in propagating the dogmas of their ſuperſtition, is abundantly evident from the extenſive ſpreading of their rites and ceremonies over almoſt all Aſia and a conſiderable part of Europe. The Greek and Roman idolatry is known to have originated from them; and numberleſs monuments of their impious worſhip are ſtill extant in Perſia ‡, India, Japan, Tartary, &c. Our inference then is, that the worſhip of Iſis was introduced into every country where Triptolemus ſold or diſpoſed of his commodities.—Hence the wanderings of Ceres in ſearch of her daughter Proſerpine, who is generally called *Core*. The famine occaſioned by the drought deſtroying the fruits of the ground, imports the loſs of Proſerpine. The reſtoration of the corn in various parts of the earth, by freſh ſupplies from Egypt from time to time, imports the wanderings of Ceres in queſt of Proſerpine. The whole proceſs is an oriental allegory. The diſappearing of the fruits of the earth, of which Proſerpine, or Perſephone*, or Pereſephone(Y), is the emblem, is the allegorical rape of that goddeſs. She was ſeized and carried off by Pluto, ſovereign of the infernal regions. The ſeed committed to the earth in that dry ſeaſon appeared no more, and was, conſequently, ſaid to dwell under ground with Pluto. It was then that Ceres, that is, corn imported from Egypt, ſet out in queſt of her daughter. Again, when the earth recovered her priſtine fertility, the Core, or maid, was found by her mother Ceres, that is, the earth; for Iſis, among the Egyptians frequently ſignified the earth. The wanderings of Iſis in ſearch of Oſiris furniſhed the model for the peregrinations of Ceres.

§ *Herod. Lib.* 2.

‡ *Aſiatic Reſearches*, vol. i. and ii.

* *Plutarch. Iſis et Oſir.*

44 Different names of Ceres.

Ceres, the Roman name of the goddeſs of corn, was unknown to the modern Greeks. They always denominated her *Damater*(Z), which is rather an epithet than a proper name. The Greeks, who always affected to paſs for originals, we think ſuppreſſed the Egyptian name on purpoſe, to conceal the country of that deity. As a proof of the probability of this conjecture it may be obſerved, that they metamorphoſed the wanderings of Iſis in ſearch of Oſiris into the peregrinations of Ceres in queſt of Proſerpine. The Romans, who were leſs ambitious of the character of originality, retained one of her oriental names(A). Ceres, ſays Diodorus, appeared thrice in Attica during the reign of Erectheus; which ſeems to import, that fleets loaded with corn had thrice arrived in that country from Egypt during that period.

Cecrops the firſt king of Attica had eſtabliſhed the worſhip of the Saitic Athena or Minerva in that region, and conſecrated his capital to that deity. Erectheus, in his turn, introduced the worſhip of Iſis or Damater, who in all appearance was the tutelar deity of Buſiris his native city. The ſubjects of Cecrops were a colony of Saites, and readily embraced the worſhip of Minerva; but the aborigines of that diſtrict being accuſtomed to a maritime, perhaps to a piratical, courſe of life, were more inclined to conſecrate their city to Neptune the god of the ſea, and to conſtitute him their guardian and protector. Cecrops by a ſtratagem ſecured the preference to Minerva his favourite divinity. Erectheus, in order to give equal importance to his patroneſs, had the addreſs to inſtitute the Eleuſinian myſteries; and to accompliſh his deſign laid hold on the opportunity above mentioned.

45 Contentions at Athens reſpecting Minerva and Neptune, the immediate cauſe of fixing the myſteries at Eleuſis.

This appears to us the moſt probable account of the origin and inſtitution of the Eleuſinian myſteries; for which the Sicilian hiſtorian has indeed furniſhed the clue. We ſhall now proceed to detail ſome other circumſtances which attended the original inſtitution of theſe far-famed ceremonies.

The archprieſteſs who perſonated the newly imported deity was entertained by one Celeus *, who was either viceroy of that petty diſtrict of which Eleuſis was the capital, or ſome conſiderable perſonage in that city or its neighbourhood. Upon her immediate arrival, according to the fabulous relations of the Greeks, a farce was acted not altogether ſuitable to the character of a goddeſs whoſe myſteries were one day to be deemed ſo ſacred and auſtere. Theſe coarſe receptions, and other indecencies attending the firſt appearance of the goddeſs, that is, the Egyptian dame who aſſumed her character, were copied from the like unhallowed modes of behaviour practiſed on occaſion of the ſolemn proceſſions of her native country. Theſe ſcommata, or coarſe jokes, had an allegorical ſignification in Egypt; and among the moſt ancient Greeks the very ſame ſpirit was univerſally diffuſed by the oriental coloniſts who from time to time arrived and ſettled among them. In proceſs of time they abandoned the figurative and allegorical ſtyle, in conſequence of their acquaintance with philoſophy and abſtract reaſoning.

* *Apol'od. Bibl. Lib.* 3. *cap.* 13.

46 Circumſtances attending the firſt appearance of Ceres in Attica.

(Y) This word ſeems to be formed of two Hebrew terms, *pheri* "fruit," and *tzaphon*, or *tzephon*, "abſcondit, recondidit."

(Z) Damater is compounded of the Chaldiac particle *da* "the," and *mater* "mother." As Iſis often ſignified the earth, the Greeks naturally adopted that title; becauſe, according to them, that element is the mother of all living. In the very ſame manner they diſcarded the word *Juno*, an original title of the moon, and ſubſtituted *Hera*, which intimates "miſtreſs or lady."

(A) According to ſome of the Latin etymologiſts, *Ceres*, or rather *Geres*, is derived from *gero* "to bear, to carry," becauſe the earth bears all things; or becauſe that element is the general fruit-bearer. But as this term came to Italy immediately from the eaſt, and not by the medium of Greece, we would rather incline to adopt an oriental etymology. The Hebrew word *cheres* ſignifies *arare* "to plow;" a name naturally applicable to the goddeſs of huſbandry.

reaſoning. In the ceremonies of religion, however, the ſame allegorical and typical repreſentations which had been imported from the eaſt were retained; but the Grecian hierophants in a ſhort time loſt every idea of their latent import, and religious, moral, or phyſical interpretation. Accordingly, this ſhameful rencounter between Ceres and Banbo(B), or Jambe, was retained in the myſteries, though we think it was copied from Egypt, as was ſaid above, where even that obſcene action was probably an allegorical repreſentation of ſomething very different from what appeared to the Greeks.

At the ſame time that Ceres arrived in Attica, Bacchus likewiſe made his appearance in that country. He was entertained by one Icarus; whom, as a reward for his hoſpitality, he inſtructed in the art of cultivating the vine, and the method of manufacturing wine. Thus it appears that both agriculture and the art of managing the vintage were introduced into Athens much about the ſame time. Ceres was no other than a prieſteſs of Iſis; Bacchus was no doubt a prieſt of Oſiris. The arrival of thoſe two perſonages from Egypt, with a number of inferior prieſts in their train, produced a memorable revolution in Athens, both with reſpect to life, manners, and religion. The ſacred rites of Iſis, afterwards ſo famous under the name of the Eleuſinian myſteries, date their inſtitution from this period.

47 Ceres and Bacchus, who they were.

When this company of propaganda arrived at Eleuſis, they were entertained by ſome of the moſt reſpectable perſons who then inhabited that diſtrict. Their names, according to Clem. Alexand. were Banbo, Dyſaulis, Triptolemus, Eumolpus, and Eubulus. From Eumolpus were deſcended a race of prieſts called Eumolpidæ, who figured at Athens many ages after. Triptolemus was an ox-herd, Eumolpus a ſhepherd, and Eubulus a ſwine-herd. Theſe were the firſt apoſtles of the Eleuſinian myſteries. They were inſtructed by the Egyptian miſſionaries; and they, in their turn, inſtructed their ſucceſſors. Erechtheus, or, as ſome ſay, Pandion, countenanced the ſeminary, and built a ſmall temple for its accommodation in Eleuſis, a city of Attica, a few miles weſt from Athens, and originally one of the twelve diſtricts into which that territory was divided. Here then we have arrived at the ſcene of thoſe renowned myſteries, which for the ſpace of near 2000 years were the pride of Athens and the wonder of the world.

48 Eleuſinian myſteries divided into greater and leſſer.

The myſteries were divided into the greater and leſſer. The latter were celebrated at Agræ, a ſmall town on the river Ilyſſus: the former were celebrated in the month which the Athenians called Boedromion (C); the latter in the month Antheſterion (D). The leſſer myſteries, according to the fabulous legends of the Greeks, were inſtituted in favour of the celebrated Hercules. That hero being commanded by Euryſtheus to bring up Cerberus from the infernal regions, was deſirous of being initiated in the Eleuſinian myſteries before he engaged in that perilous undertaking. He addreſſed himſelf to Eumolpus the hierophant for that purpoſe. There was a law among the Eleuſinians prohibiting the initiation of foreigners. The prieſt not daring to refuſe the benefit to Hercules, who was both a friend and benefactor to the Athenians, adviſed the hero to get himſelf adopted by a native of the place, and ſo to elude the force of the law. He was accordingly adopted by one Pyolius, and ſo was initiated in the leſſer myſteries, which were inſtituted for the firſt time upon that occaſion. This account has all the air of a fable. The leſſer myſteries were inſtituted by way of preparation for the greater.

49 Auſterities and rites previous to initiation.

The perſon who was to be initiated in the leſſer myſteries, as well as in the greater, was obliged to practiſe the virtue of chaſtity a conſiderable time before his admiſſion. Beſides, he was to bind himſelf by the moſt ſolemn vows not to divulge any part of the myſteries. At the ſame time, he was, according to the original inſtitution, to be a perſon of unblemiſhed moral character. Theſe were preliminaries indiſpenſably neceſſary in order to his admiſſion. A bull was ſacrificed to Jupiter, and the hide of that animal, called by a peculiar name (Διος Κωδιον), was carefully preſerved and carried to Eleuſis, where it was ſpread under the feet of the initiated. The candidate was then purified by bathing in the river Ilyſſus, by aſperſions with ſalt water or ſalt, with laurel barley, and paſſing through the fire: all which rites were attended with incantations and other uſages equally inſignificant and ridiculous. Laſt of all, a young ſow was ſacrificed to Ceres; and this animal, according to the ritual, behoved to be with pigs: and before it was killed it was to be waſhed in Cantharus, one of the three harbours which formed the Piræus.

50 Into the leſſer myſteries; of which

All theſe ceremonies duly performed, the candidate was carried into the hall appointed for the purpoſe of initiation. There he was taught the firſt elements of thoſe arcana which were afterwards to be more fully and more clearly revealed in the more auguſt myſteries of Eleuſis. The pupils at Agræ were called *Myſtæ*, which may intimate probationers; whereas thoſe of Eleuſis were denominated *Epoptæ*, importing that they ſaw as they were ſeen.

51 There were ſeveral ſtages, with long intervals between them.

The leſſer myſteries were divided into ſeveral ſtages, and candidates were admitted to them according to their quality and capacity reſpectively. Thoſe who were initiated in the loweſt were obliged to wait five years before they were admitted to the greater. Thoſe who had partaken of the ſecond kind underwent a noviciate of three years; thoſe who had been admitted to the third, one of two years; and thoſe who had gone through the fourth were admitted to the greater at the end of one year; which was the ſhorteſt period of probation a candidate for that honour could legally undergo. Such was the proceſs generally obſerved in adminiſtering the leſſer myſteries.

With

(B) Apollod. Bib. ubi ſupra. Clem. Alexand. Cahod. page 17. where the ſtory is told with very little reſerve.

(C) The third month of the Athenian year, anſwering to our September.

(D) The eighth month, anſwering to our February; but Meurſius makes it November.

52 None but natives of Athens originally admitted to the greater mysteries.

With respect to the greater mysteries, it is probable that originally none but the natives of Attica were admitted to partake of them. In process of time, however, the pale was extended so far and wide as to comprehend all who spoke the Greek language. All foreigners were debarred from those sacred rites. They tell us, however, that Hercules, Bacchus, Castor and Pollux, Æsculapius and Hippocrates, were initiated in an extraordinary manner, from a regard to their high character and heroic exploits. All barbarians, too, were excluded; yet Anacharsis the Scythian was indulged that privilege, in consequence of his reputation for science and philosophy. All persons guilty of manslaughter, though even accidentally or involuntarily, all magicians, enchanters; in a word, all impious and profane persons, were expressly prohibited the benefit of this pagan sacrament. At last, however, the gate became wider, and crowds of people, of all nations, kindreds, and languages, provided their character was fair and irreproachable, rushed in by it. In process of time the Athenians initiated even their infants; but this, we imagine, must have been a kind of lustration or purification from which it was supposed that they derived a kind of moral ablution from vice, and were thought to be under the peculiar protection of the goddess.

53 Celebration lasted nine days; but

The celebration of the mysteries began on the 15th day of the month Boedromion; and, according to most ancient authors, lasted nine days. Meursius has enumerated the transactions of each day, which are much too numerous to fall within the compass of this article; we must therefore refer our curious reader to the author just mentioned. Some days before the commencement of the festival, the præcones, or public criers, invited all the initiated, and all the pretenders to that honour, to attend the festival, with clean hands and a pure heart, and the knowledge of the Greek language.

54 Was performed only during the night.

On the evening of the 15th day of the month called *Boedromion* the initiations commenced. Our readers will observe, that all the most sacred and solemn rites of the pagan superstition were performed during the night: they were indeed generally works of darkness. On this day there was a solemn cavalcade of Athenian matrons from Athens to Eleusis, in carriages drawn by oxen. In this procession the ladies used to rally one another in pretty loose terms, in imitation, we suppose, of the Isiac procession described by Herodotus, which has been mentioned above. The most

55 The Mundus Cereris.

remarkable object in this procession was the Mundus Cereris, contained in a small coffer or basket. This was carried by a select company of Athenian matrons, who, from their office, were styled *Camphoræ*. In this coffer were lodged the comb of Ceres, her mirror, a serpentine figure, some wheat and barley, the pudenda of the two sexes, and perhaps some other articles which we have not been able to discover. The procession ended at the temple, where this sacred charge was deposited with the greatest solemnity.

We have no description of the temple of Eleusis upon record. Pausanias intended to have described it; but says he was diverted from his design by a dream ‖. Strabo informs us that the mystic sanctuary was as large as a theatre, and that it was built by Ictinus*. In the porche, or outer part of this temple,

‖ *Lib.* 9.

* See *Eleusis.*

the candidates were crowned with garlands of flowers, which they called *himera*, or "the desirable." They were at the same time dressed in new garments, which they continued to wear till they were quite worn out. They then washed their hands in a laver filled with holy water; a ceremony which intimated the purity of their hearts and hands. Before the doors were locked, one of the officers of the temple proclaimed with a loud voice a stern mandate, enjoining all the uninitiated to keep at a distance from the temple, and denouncing the most terrible menaces if any should dare to disturb or pry into the holy mysteries. Nor were these menaces without effect: for if any person was found to have crowded into the sanctuary even through ignorance, he was put to death without mercy. Every precaution having been taken to secure secrecy, the initiatory ceremonies now began. But before we describe these, we must lay before our readers a brief account of the ministers and retainers of these secrets of paganism.

56 Dress of the candidates.

57 Care to keep the uninitiated at a distance.

58 The hierophant.

The chief minister of these far-famed mysteries was the Hierophant. He was styled *King*, and enjoyed that dignity during life, and was always by birth an Athenian. He presided in the solemnity, as is evident from his title. This personage, as we learn from Eusebius, represented the Demiurgus, or Creator of the world. "Now in the mysteries of Eleusis (says that father) the hierophant is dressed out in the figure of the demiurgus." What this demiurgus was, we learn from the same writer. As this whole institution was copied from the Egyptians, we may rest assured that the figure of the Eleusinian Demiurgus was borrowed from the same quarter. "As for the symbols of the Egyptians (says he, quoting from Porphyry*), they are of the following complexion. The Demiurgus, whom the Egyptians call *Cneph*, is figured as a man of an azure colour, shaded with black, holding in his right hand a sceptre and in his left a girdle, and having on his head a royal wing or feather wreathed round." Such, we imagine, was the equipment of the Eleusinian hierophant. This person was likewise styled *Prophet*. He was to be of the family of the Eumolpidæ; was obliged to make a vow of perpetual chastity; and even his voice, hair, and attitude, were adjusted to the ritual.

* *Præp. Evan.*

59 The daduchus.

The next minister was the Daduchus, or torch-bearer; who, according to the father above quoted, was attired like the sun. This minister resembled the sun, because that luminary was deemed the visible type of the supreme Demiurgus, and his vicegerent in governing and arranging the affairs of this lower world.

60 The priests.

The third was the person who officiated at the altar. He was habited like the moon. His office was to implore the favour of the gods for all the initiated. We should rather imagine, that the person at the altar, as he resembled the moon, was intended to represent the goddess herself: for the Egyptian Isis, who was the archetype of Ceres, was sometimes the moon and sometimes the earth.

61 The herald.

The sacred herald was another principal actor in this solemn exhibition. His province was to recite every thing that, according to the ritual, was to be communicated to the novices; and he probably represented Thyoth or Thoth, that is Hermes or Mercury, the interpreter of the gods.

62 The curators, &c.

Beſides theſe, there were five epimeletæ or curators, of whom the king was one, who jointly directed the whole ceremonial. Laſtly, there were ten prieſts to offer the ſacrifices. There were no doubt many officers of inferior note employed upon theſe occaſions; but theſe were only inſignificant appendages, whoſe departments have not been tranſmitted to poſterity.

After this detail of the miniſters of this ſolemn ſervice, we return to the *myſtæ*, or candidates for initiation. Some of the fathers of the church† mention a hymn compoſed by the celebrated Orpheus, which was ſung by the myſtagogue or king upon that occaſion. This hymn appears to us one of thoſe ſpurious compoſitions which abounded in the firſt ages of Chriſtianity, and which the pious apologiſts often adopted without ſufficient examination. That ſome ſacred hymn was chanted upon that occaſion, we think highly probable; but that the one in queſtion was either compoſed by Orpheus, or uſed at the opening of theſe ceremonies, to us appears ſomewhat problematical.

† *Juſtin. Euſeb. Clem. Alex.*

Before the ceremony opened, a book was produced, which contained every thing relating to the teletæ. This was read over in the ears of the myſtæ; who were ordered to write out a copy of it for themſelves. This book was kept at Eleuſis in a ſacred repoſitory, formed by two ſtones exactly fitted to each other, and of a very large ſize. This repoſitory was called *petroma*. At the annual celebration of the greater myſteries, theſe ſtones were taken aſunder, and the book taken out; which, after being read to the myſtæ, was replaced in the ſame caſement.

63 The petroma.

64 Commencement of the initiations.

The initiations began with a repreſentation of the wanderings of Ceres, and her bitter and loud lamentations for the loſs of her beloved daughter. Upon this occaſion, no doubt, a figure of that deity was diſplayed to the myſtæ, while loud lamentations echoed from every corner of the ſanctuary. One of the company having kindled a firebrand at the altar, and ſprung to a certain place in the temple, waving the torch with the utmoſt fury, a ſecond ſnatched it from him, roaring and waving it in the ſame frantic manner; then a third, fourth, &c. in the moſt rapid ſucceſſion. This was done to imitate Ceres, who was ſaid to have perluſtrated the globe of the earth with a flaming pine in her hand, which ſhe had lighted at mount Etna.

When the pageant of the goddeſs was ſuppoſed to arrive at Eleuſis, a ſolemn pauſe enſued, and a few trifling queſtions were put to the myſtæ: What theſe queſtions were, is evident from the anſwers. "I have faſted; I have drunk the liquor; I have taken the contents out of the coffer; and having performed the ceremony, have put them into the hamper: I have taken them out of the hamper, and put them again in the coffer." The meaning of theſe anſwers, we conjecture, was this: "I have faſted as Ceres faſted while in ſearch of her daughter; I have drunk off the wort as ſhe drank when given her by Banbo; I have performed what Ceres taught her firſt diſciples to perform, when ſhe committed to them the ſacred hamper and coffer." After theſe interrogatories, and the ſuitable reſponſes, the *mundus Cereris* was diſplayed before the eyes of the myſtæ, and the *myſtagogue* or hierophant, or perhaps the ſacred herald by his command, read a lecture on the allegorical import of thoſe ſacred ſymbols. This was heard with the moſt profound attention; and a ſolemn ſilence prevailed throughout the fane. Such was the firſt act of this religious farce, which perhaps conſiſted originally of nothing more.

65 Queſtions put to the myſtæ.

66 Traditions reſpecting the origin of the univerſe, &c.

After the expoſition of the *mundus Cereris*, and the import of her wanderings, many traditions were communicated to the myſtæ concerning the origin of the univerſe and the nature of things. The doctrines delivered in the greater myſteries, ſays Clem. Alex. "relate to the nature of the univerſe. Here all inſtruction ends. Things are ſeen as they are; and nature, and the things of nature, are given to be comprehended. To the ſame purpoſe Cicero: "Which points being explained and reduced to the ſtandard of reaſon, the nature of things, rather than that of the gods, is diſcovered." The Father of the univerſe, or the ſupreme demiurgus, was repreſented as forming the chaotic maſs into the four elements, and producing animals, vegetables, and all kinds of organized beings, out of thoſe materials. They ſay that they were informed of the ſecrets of the anomalies of the moon, and the eclipſes of the ſun and moon; and, according to Virgil,

Unde hominum genus, et pecudes, unde imber et ignes.

What ſyſtem of coſmogony thoſe hierophants adopted, is evident from the paſſage above quoted from Euſebius; and, from the account immediately preceding, it was that of the moſt ancient Egyptians, and of the orientals in general. This coſmogony is beautifully and energetically exhibited in Plato's Timæus, and in the genuine ſpirit of poetry by Ovid in the beginning of his Metamorphoſes.

67 Exploits of the gods, and

The next ſcene exhibited upon the ſtage, on this ſolemn occaſion, conſiſted of the exploits and adventures of the gods, demigods, and heroes, who had, from time to time, been advanced to divine honours. Theſe were diſplayed as paſſing before the myſtæ in pageants fabricated for that important purpoſe. This was the original mode among the Egyptians, and was no doubt followed by their Eleuſinian pupils. Thoſe adventures were probably demonſtrated to have been allegorical, ſymbolical, hieroglyphical, &c. at leaſt they were exhibited in ſuch a favourable point of view as to diſpel thoſe abſurdities and inconſiſtencies with which they were ſophiſticated by the poets and the vulgar.

68 Their origin.

With reſpect to the origin of thoſe factitious deities, it was diſcovered that they had been originally men who had been exalted to the rank of divinity, in conſequence of their heroic exploits, their uſeful inventions, their beneficent actions, &c. This is ſo clear from the two paſſages quoted from Cicero, by biſhop Warburton†, that the fact cannot be contradicted. But that prelate has not informed us ſo preciſely, whether the myſtagogues repreſented them as nothing more than dead men, in their preſent ſtate, or as beings who were actually exiſting in a deified ſtate, and executing the functions aſſigned them in the rubric of paganiſm. Another query naturally occurs, that is, to what purpoſe did the myſtagogues apply this communication? That the hierophants did

† *Div. Leg.*

actually repreſent thoſe deified mortals in the latter predicament, is obvious from another paſſage quoted from Cicero by the ſame prelate, which we ſhall tranſcribe as tranſlated by him: "What think you of thoſe who aſſert that valiant, or famous, or powerful men, have obtained divine honours after death; and that theſe are the very gods now become the objects of our worſhip, our prayers, and adoration? Euhemerus tells us when theſe gods died, and where they lie buried. I forbear to ſpeak of the ſacred and auguſt rites of Eleuſis. I paſs by Samothrace and the myſteries of Lemnos, whoſe hidden rites are celebrated in darkneſs, and amidſt the thick ſhades of groves and foreſts." If, then, thoſe deified mortals were become the objects of worſhip and prayers, there can be no doubt of the belief of their deified exiſtence. The alluſion to the Eleuſinian and other pagan myſteries towards the cloſe of the quotation, places the queſtion beyond the reach of controverſy. But, though, according to this account, "there were gods many and lords many;" yet it is evident from the paſſage quoted from Euſebius in the preceding part of this article, that the unity of the Supreme Being was maintained, exhibited, and inculcated. This was the original doctrine of the Hierophants of Egypt: It was maintained by Thales and all the retainers of the Ionian ſchool. It was the doctrine of Pythagoras, who probably gleaned it up in the country juſt mentioned, in connection with many other dogmas which he had the aſſurance to claim as his own.

69 Unity of the ſupreme Being maintained in the myſteries.

But however the unity, and perhaps ſome of the moſt obvious attributes of the Supreme Author of nature, might be illuſtrated and inculcated, the tribute of homage and veneration due to the ſubordinate divinities was by no means neglected. The initiated were taught to look to the *dii majorum gentium* with a ſuperior degree of awe and veneration, as beings endowed with an ineffable meaſure of power, wiſdom, purity, goodneſs, &c. Theſe were, if we may uſe the expreſſion, the prime favourites of the Monarch of the univerſe, who were admitted into his immediate preſence, and who received his beheſts from his own mouth, and communicated them to his ſubordinate officers, prefects, lieutenants, &c. Theſe they were exhorted to adore; to them they were to offer ſacrifices, prayers, and every other act of devotion, both on account of the excellency of their nature and the high rank they bore at the court of heaven. They were inſtructed to look up to hero-gods and demi-gods, as beings exalted to the high rank of governors of different parts of nature, as the immediate guardians and protectors of the human race; in ſhort, as gods near at hand, as prompters to a virtuous courſe, and aſſiſtants in it; as ready upon all occaſions to confer bleſſings upon the virtuous and deſerving. Such were the doctrines taught in the teletæ with reſpect to the nature of the Pagan divinities, and the worſhip and devotion enjoined to be offered them by the myſteries.

70 Offices of the other gods.

As the two principal ends propoſed by theſe initiations were the exerciſe of heroic virtues in men, and the practice of ſincere and uniform piety by the candidates for immortal happineſs, the hierophants had adopted a plan of operations excellently accommodated to both theſe purpoſes. The virtuous conduct and heroic exploits of the great men and demigods of early antiquity, were magnified by the moſt pompous elogiums, enforced with ſuitable exhortations to animate the votaries to imitate ſo noble and alluring an example. But this was not all: the heroes and demigods themſelves were diſplayed in pageants, or vehicles of celeſtial light. Their honours, offices, habitations, attendants, and other appendages, in the capacity of demons, were exhibited with all the pomp and ſplendor that the ſacerdotal college were able to deviſe. The ſudden glare of mimic light, the melting muſic ſtealing upon the ear, the artificial thunders reverberated from the roof and walls of the temple, the appearance of fire and etherial radiance, the vehicles of flame, the effigies of heroes and demons adorned with crowns of laurel emitting rays from every ſprig, the fragrant odours and aromatic gales which breathed from every quarter, all dexterouſly counterfeited by ſacerdotal mechaniſm, muſt have filled the imagination of the aſtoniſhed votaries with pictures at once tremendous and tranſporting: Add to this, that every thing was tranſacted in the dead of night amidſt a diſmal gloom; whence the moſt bright effulgence inſtantaneouſly burſt upon the ſight. By this arrangement the aſpirants to initiation were wonderfully animated to the practice of virtue while they lived, and inſpired with the hope of a bleſſed immortality when they died. At the ſame time, their awe and veneration for the gods of their country was wonderfully enhanced by reflecting on the appearances above deſcribed. Accordingly Strabo very judiciouſly obſerves, "that the myſtical ſecrecy of the ſacred rites preſerves the majeſty of the Deity, imitating its nature, which eſcapes our apprehenſion. For theſe reaſons, in celebrating the teletæ, the demons were introduced in their deified or glorified ſtate.

71 Excellent plan for accompliſhing the ends propoſed in the myſteries.

But as all the candidates for initiation might not aſpire to the rank of heros and demigods, a more eaſy and a more attainable mode of conduct, in order to arrive at the palace of happineſs, behoved to be opened. Private virtues were inculcated, and theſe too were to meet a condign reward. But alas! this preſent life is too often a chequered ſcene, where virtue is depreſſed and trodden under foot, and vice lifts up its head and rides triumphant. It is a dictate of common ſenſe, that virtue ſhould ſooner or later emerge, and vice ſink into contempt and miſery. Here then the conductors of the myſteries, properly and naturally, adopted the doctrine of a future ſtate of rewards and puniſhments. The dogma of the immortality of the human ſoul was elucidated, and carefully and pathetically inculcated. This doctrine was likewiſe imported from Egypt; for Herodotus‡ informs us, "that the Egyptians were the firſt people who maintained the immortality of the human ſoul." The Egyptian immortality, however, according to him, was only the metempſychoſis or tranſmigration of ſouls. This was not the ſyſtem of the ancient Egyptians, nor indeed of the teletæ. In theſe, a metempſychoſis was admitted; but that was carried forward to a very diſtant period, to wit, to the grand Egyptian period of 36,000 years.

72 Private virtues inculcated in the myſteries, by the doctrine of a future ſtate.

‡ *Lib.* 2.

As the myſtagogues well knew that the human mind is more powerfully affected by objects preſented to the eyes than by the moſt engaging inſtructions conveyed by

73 Emblems of Elyſium and Tartarus.

by the ear, they made the emblems of Elyſium and Tartarus paſs in review before the eyes of their novices. There the Elyſian ſcenes, ſo nobly deſcribed by the Roman poet, appeared in mimic ſplendor; and, on the other hand, the gloom of Tartarus, Charon's boat, the dog of hell, the furies with treſſes of ſnakes, the tribunal of Minos and Rhadamanthus, &c. were diſplayed in all their terrific ſtate. Tantalus, Ixion, Siſyphus, the daughters of Danaus, &c. were repreſented in pageants before their eyes. Theſe exhibitions were accompanied with moſt horrible cries and howlings, thunders, lightning, and other objects of terror, which we ſhall mention in their proper place.

No contrivance could be better accommodated to animate the pupils to the practice of virtue on the one hand, or to deter them from indulging vicious paſſions on the other. It reſembled opening heaven and hell to a hardened ſinner. The practices inculcated in celebrating the myſteries are too numerous to be detailed in this imperfect ſketch. The worſhip of the gods was ſtrictly enjoined, as has been ſhown above. The

74 The three laws of Triptolemus.

three laws generally aſcribed to Triptolemus were inculcated, 1. To honour their parents; 2. To honour the gods with the firſt fruits of the earth; 3. Not to treat brute animals with cruelty. Theſe laws were imported from Egypt, and were communicated to the Eleuſinians by the original miſſionaries. Cicero makes the civilization of mankind one of the moſt beneficial effects of the Eleuſinian inſtitutions: "Nullum mihi, cum multa eximia divinaque videntur Athenæ tuæ peperiſſe; tum nihil melius illis myſteriis, quibus ex agreſti immanique vita, exculti ad humanitatem, et mitigati ſumus; initiaque, ut appellantur, ita revera principia vitæ cognovimus; neque ſolum cum lætitia vivendi rationem accepimus, ſed etiam cum ſpe meliore moriendi." Hence it is evident, that the precepts of humanity and morality were warmly recommended in theſe inſtitutions. The virtue of humanity was extended, one may ſay, even to the brute creation, as appears from the laſt of Triptolemus's laws above quoted. Some articles were enjoined in the teletæ which may appear to us of leſs importance, which, however, in the ſymbolical ſtyle of the Egyptians, were abundantly ſignificant. The initiated were "commanded to abſtain from the fleſh of certain birds and fiſhes; from beans, from pomegranates and apples, which were deemed equally polluting. It was taught, that to touch the plant of aſparagus was as dangerous as the moſt deadly poiſon. Now, ſays Porphyry, whoever is verſed in the hiſtory of the *viſions*, knows for what reaſon they were commanded to abſtain from the fleſh of birds."

75 The initiated bound themſelves by oaths to obſerve the precepts of the myſteries.

The initiated then bound themſelves by dreadful oaths to obſerve moſt conſcientiouſly and to practiſe every precept tendered to them in the courſe of the teletæ; and at the ſame time never to divulge one article of all that had been heard or ſeen by them upon that occaſion. In this they were ſo exceedingly jealous, that Æſchylus the tragedian was in danger of capital puniſhment for having only alluded to one of the Eleuſinian arcana in a tragedy of his; and one of the articles of indictment againſt Diagoras the Melian was, his having ſpoken diſreſpectfully of the myſteries, and diſſuaded people from partaking of them. It muſt then be allowed, that the inſtitution of the myſteries was of infinite advantage to the pagan world. They were indeed a kind of ſacraments, by which the initiated bound themſelves by a ſolemn vow to practiſe piety towards the gods, juſtice and humanity towards their fellow-men, and gentleneſs and tenderneſs towards the inoffenſive part of the brute creation. The pagans themſelves were ſo thoroughly convinced of this fact, that in their diſputes with the apologiſts for Chriſtianity, they often appealed to the teletæ, and contraſted their maxims with the moſt ſublime doctrines of that heavenly inſtitution.

In order to impreſs theſe maxims the more deeply upon the minds of the novices, and to fix their attention more ſtedfaſtly upon the lectures which were delivered them by the myſtagogue or the ſacred herald, a mechanical operation was played off at proper intervals during the courſe of the celebration. "Towards the end of the celebration (ſays Stobæus), the whole ſcene is terrible; all is trembling, ſhuddering, ſweat, and aſtoniſhment. Many horrible ſpectres are ſeen, and ſtrange cries and howlings uttered. Light ſucceeds darkneſs; and again the blackeſt darkneſs the moſt glaring light. Now appear open plains, flowery meads, and waving groves; where are ſeen dances and choruſes; and various holy phantaſies enchant the ſight. Melodious notes are heard from far, with all the ſublime ſymphony of the ſacred hymns. The pupil now is completely perfect, is initiated, becomes free, releaſed, and walks about with a crown on his head, and is admitted to bear a part in the ſacred rites." Ariſtides de Myſt. Eleuſ. calls Eleuſis "a kind of temple of the whole earth, and of all that man beholds done in the moſt dreadful and the moſt exhilerating manner. In what other place have the records of fable ſung of things more marvellous? or in what region upon earth have the objects preſented to the eye bore a more exact reſemblance to the ſounds which ſtrike the ear? What object of ſight have the numberleſs generations of men and women beheld comparable to theſe exhibited in the ineffable myſteries?" To the ſame purpoſe, Pletho, in the oracles of Zoroaſtres, informs us, "that frightful and ſhocking apparitions, in a variety of forms, uſed to be diſplayed to the myſtæ in the courſe of their initiation." And a little after, he adds, "that thunder and lightning and fire, and every thing terrible which might be held ſymbolical of the divine preſence, was introduced." Claudian, in his poem *De Rapta Proſerpina*, gives an elegant, though brief, deſcription of this phenomenon, which throws ſome light on the paſſages above quoted.

76 Horrible ſpectres and pleaſing ſcenes alternately exhibited.

> "*Jam mihi cernuntur trepidis delubra moveri*
> "*Sedibus et clarum dis pergere culmina lucem,*
> "*Adventum teſtata Dea, jam magnus ab imis*
> "*Auditur fremitus terris, templumque remugit*
> "*Cecropidum.*"

The ſight of thoſe appearances was called the *Antopſia*, or "the real preſence:" hence thoſe rites were ſometimes called *Epoptica*. The *Epoptæ* were actually initiated, and were admitted into the *Sanctum Sanctorum*, and bore a part in the ceremonial; whereas the *myſtæ*, who had only been initiated in the leſſer myſteries at Agræ, were obliged to take their ſtation in the porch

77 A kind of baptiſmal ablution in the myſteries.

of the temple. The candidates for initiation bathed themſelves in holy water, and put on new clothes, all of linen, which they continued to wear till they were quite torn, and then they were conſecrated to Ceres and Proſerpine. From the ceremony of bathing they were denominated *Hydrani;* and this again was a kind of baptiſmal ablution. Whether the phraſes of *waſhing away ſin, putting on the Lord Jeſus Chriſt, putting off the old man with his deeds, putting on a robe of righteouſneſs, being buried in baptiſm*, the words *myſtery, perfect, perfection*, which occur ſo frequently in the New Teſtament, eſpecially in the writings of the apoſtle St Paul, are borrowed from the pagan myſteries, or from uſages current among the Jews, we leave to our more learned readers to determine.

78 The initiated declared perfect men.

The Epoptæ having ſuſtained all thoſe fiery trials, heard and ſeen every thing requiſite, taken upon them the vows and engagements above narrated, and, in a word, having ſhown themſelves good ſoldiers of Ceres and Proſerpine, were now declared *perfect men*. They might, like Cebes's *virtuous man*, travel wherever they choſe: thoſe wild beaſts (the human paſſions) which tyranniſe over the reſt of mankind, and often deſtroy them, had no longer dominion over them. They were now not only *perfect* but *regenerated* men. They were now crowned with laurel, as was ſaid above, and diſmiſſed with two barbarous words, Κογξ, ὀμπαξ, *Konx ompax*, of which perhaps the Hierophants themſelves did not comprehend the import. They had been introduced by the firſt Egyptian miſſionaries, and retained in the ſacra after their ſignification was loſt. This was a common practice among the Greeks. In the adminiſtration of their religious ceremonies, they retained many names of perſons, places, things, cuſtoms, &c. which had been introduced by the Phœnicians and Egyptians, from whom they borrowed their ſyſtem of idolatry. Thoſe terms conſtituted the language of the gods, ſo often mentioned by the prince of poets. To us the words in queſtion appear to be Syriac, and to ſignify, *Be vigilant, be innocent*.

Numerous and important were the advantages ſuppoſed to redound to the initiated, from their being admitted to partake of the myſteries, both in this life and that which is to come. Firſt, they were highly honoured, and even revered, by their contemporaries. Indeed, they were looked up to as a kind of ſacred perſons: they were, in reality, conſecrated to Ceres and Proſerpine. Secondly, they were obliged by their oath to practiſe every virtue, religious, moral, political, public, and private. Thirdly, they imagined, that found advice and happy meaſures of conduct were ſuggeſted to the initiated by the Eleuſinian goddeſſes. Accordingly, ſays Pericles the celebrated Athenian ſtateſman, "I am convinced, that the deities of Eleuſis inſpired me with this ſentiment, and that this ſtratagem was ſuggeſted by the principal of the myſtic rites." There is a beautiful paſſage in Ariſtophanes's* comedy of the Ranæ to the very ſame purpoſe, of which we ſhall ſubjoin the following periphraſis. It is ſung by the chorus of the initiated.

* *Act* 1.

Let us to flow'ry meads repair,
With deathleſs roſes blooming,
Whoſe balmy ſweets impregn the air,
Both hills and dales perfuming.
Since fate benign our choir has join'd,
We'll trip in myſtic meaſure;
In ſweeteſt harmony combin'd
We'll quaff full draughts of pleaſure.
For us alone the pow'r of day
A milder light diſpenſes;
And ſheds benign a mellow'd ray
To cheer our raviſh'd ſenſes:
For we beheld the myſtic ſhow,
And brav'd Eleuſis' dangers.
We do and know the deeds we owe
To neighbours, friends, and ſtrangers.

Euripides, in his Bacchæ (E), introduces the chorus extolling the happineſs of thoſe who had been acquainted with God, by participating in the holy myſteries, and whoſe minds had been enlightened by the myſtical rites. They boaſt, "that they had led a holy and unblemiſhed life, from the time that they had been initiated in the ſacred rites of Jupiter Idæus, and from the time that they had relinquiſhed celebrating the nocturnal rites of Bacchus, and the banquets of raw fleſh torn off living animals." To this ſanctity of life they had no doubt engaged themſelves, when they were initiated in the myſteries of that god. The Eleuſinian Epoptæ derived the ſame advantages from their ſacramental engagements. Fourthly, The initiated were imagined to be the peculiar wards of the Eleuſinian goddeſſes. Theſe deities were ſuppoſed to watch over them, and often to avert impending danger, and to reſcue them when beſet with troubles.—Our readers will not imagine that the initiated reaped much benefit from the protection of his Eleuſinian tutelary deities; but it was ſufficient that they believed the fact, and actually depended upon their interpoſition. Fifthly, The happy influences of the teletæ, were ſuppoſed to adminiſter conſolation to the Epoptæ in the hour of diſſolution; for, ſays Iſocrates, "Ceres beſtowed upon the Athenians two gifts of the greateſt importance; the fruits of the earth, which were the cauſe of our no longer leading a ſavage courſe of life; and the teletæ, for they who partake of theſe entertain more pleaſant hopes both at the end of life, and eternity afterwards." Another author * tells us, "that the initiated were not only often reſcued from many hardſhips in their lifetime, but at death entertained hopes that they ſhould be raiſed to a more happy condition." Sixthly, After death, in the Elyſian fields, they were to enjoy ſuperior degrees of felicity, and were to baſk in eternal ſunſhine, to quaff nectar, and feaſt upon ambroſia, &c.

* *Ariſtides de Myſt. El.*

79 Intereſtedneſs of the prieſts.

The prieſts were not altogether diſintereſted in this ſalutary proceſs. They made their diſciples believe, that the ſouls of the uninitiated, when they arrived in the infernal regions, ſhould roll in mire and dirt, and with very great difficulty arrive at their deſtined manſion.

(E) Act 1. near the beginning, and in many other places.

sion. Hence Plato introduces Socrates ‡ observing, "that the sages who instituted the teletæ had positively affirmed, that whatever soul should arrive in the infernal mansions *unhousell'd* and *unanneal'd*, should lie there immersed in mire and filth." And as to a future state (says Aristides), "the initiated shall not roll in mire and grope in darkness; a fate which awaits the unholy and uninitiated." It is not hard to conceive with what a commanding influence such doctrines as these must have operated on the generality of mankind.

‡ *Phædo.*

80 Remarks of Diogenes and Antisthenes.

When the Athenians advised Diogenes to get himself initiated, and enforced their arguments with the above considerations, "It will be pretty enough (replied the philosopher) to see Agesilaus and Epaminondas wallowing in the mire, while the most contemptible rascals who have been initiated are strutting in the islands of bliss."

When Antisthenes was to be initiated in the Orphic mysteries, and the priest was boasting of the many astonishing benefits which the initiated should enjoy in a future state ‡, "Why, forsooth, (says Antisthenes), 'tis wonder your reverence don't e'en hang yourself in order to come at them the sooner."

‡ *Diog. Laert.*

81 All the world crowd to Eleusis.

When such benefits were expected to be derived from the mysteries, no wonder if all the world crowded to the Eleusinian standard. After the Macedonian conquests, the Hierophants abated much of their original strictness. By the age of Cicero, Eleusis was a temple whether all nations resorted to partake of the benefits of that institution. We find that almost all the great men of Rome were initiated. The Hierophants, however, would not admit Nero on account of the profligacy of his character. Few others were refused that honour; even the children of the Athenians were admitted. But this, we think, was rather a lustration or consecration, than an initiation. Perhaps it paved the way for the more august ceremony, as the Christian baptism does among us for the other sacrament.

82 Degeneracy of the mysteries.

That this institution gradually degenerated, can hardly be questioned; but how much, and in what points, we have not been able to investigate. The fathers of the church, from whom that charge is chiefly to be collected, are not always to be trusted, especially when they set themselves to arraign the institutions of Paganism. There were indeed several ancient authors, such as Melanthius, Menander, Sotades, &c. who wrote purposely on the subject in question; but their works are long since irrecoverably lost. For this reason, modern writers, who have professedly handled it, have not always been successful in their researches. The two who have laboured most indefatigably, and perhaps most successfully, in this field, are Meursius and Warburton. The former, in his *Liber Singularis*, has collected every thing that can be gleaned from antiquity relating to the ceremonial of these institutions, without, however, pointing out their original, or elucidating the end and import of their establishment. The latter has drawn them into the vortex of a system which has in many instances led him to ascribe to them a higher degree of merit than we think they deserve. These instances we would willingly have noticed in our progress, had the limits prescribed us admitted such a discussion.

If we may believe Diodorus the Sicilian, these mysteries, which were celebrated with such wonderful secrecy at Eleusis, were communicated to all mankind among the Cretans. This, however, we think, is rather problematical. We imagine that excellent historian has confounded the mysteries of Cybele with those of the Eleusinian Ceres. These two deities were undoubtedly one and the same, that is, the moon or the earth. Hence it is probable, that there was a striking resemblance between the sacred mysteries of the Cretans and Eleusinians.

This institution continued in high reputation to the age of St Jerome, as appears from the following passage: "Hierophantæ quoque Athenienſium legant usque hodie cicutæ sorbitione castrari." The Emperor Valentinianus intended to have suppressed them; but Zozimus ‡, informs us, that he was diverted from his design by the proconsul of Greece. At length Theodosius the elder, by an imperial edict prohibited the celebration of these as well as of all the other sacra of Paganism. These mysteries, instituted in the reign of Erectheus, mantained their ground to the period just mentioned, that is, near 2000 years; during which space, the celebration of them never had been interrupted but once. When Alexander the Great massacred the Thebans and razed their city, the Athenians were so much affected with this melancholy event, that they neglected the celebration of that festival.

‡ *Adverſ. Jovin.*

83 Abolished by the emperor Theodosius.

84 Other mysteries among the pagans of less celebrity.

There were almost numberless other mysterious institutions among the ancient Pagans, of which these sketched above were the most celebrated. The Samothracian mysteries, instituted in honour of the Cabiri, were likewise of considerable celebrity, and were supposed to confer much the same blessings with the Eleusinian, but were not of equal celebrity. The Cabiri were Phœnician and likewise Egyptian ‡ deities. The learned Bochart has explained their origin, number, names, and some part of their worship. The Orphic mysteries were likewise famous among the Thracians. Orpheus learned them in Egypt, and they were nearly the same with the sacra Bacchanalia of the Greeks. There were likewise the mysteries of Jupiter Idæus in great request among the Cretans, those of the Magna Mater or Cybele, celebrated in Phrygia. To enumerate and detail all these would require a complete volume. We hope our readers will be fully satisfied with the specimen exhibited above. We are convinced many things have been omitted which might have been inserted, but we have collected the most curious and the most important.—Every one of the positions might have been authenticated by quotations from authors of the most undoubted credibility, but that process would have swelled the article beyond all proportion.

‡ *Sanchoniathon* and *Herodotus.*

MYSTICAL,

Myſtical, Myſtics.

MYSTICAL, ſomething myſterious or allegorical. Some of the commentators on the ſacred writings, beſides a literal find alſo a myſtical meaning. The ſenſe of ſcripture, ſay they, is either that immediately ſignified by the words and expreſſions in the common uſe of language; or it is mediate, ſublime, typical, and myſtical. The literal ſenſe they again divide into proper literal, which is contained in the words taken ſimply and properly; and metaphorical literal, where the words are to be taken in a figurative and metaphorical ſenſe. The myſtical ſenſe of ſcripture they divide into three kinds: the firſt correſponding to faith, and called *allegorical*; the ſecond to hope, called *anagogical*; and the third to charity, called the *tropological ſenſe*. And ſometimes they take the ſame word in ſcripture in all the four ſenſes: thus the word *Jeruſalem*, literally ſignifies the capital of Judea; allegorically, the church militant; tropologically, a believer; and anagogically, heaven. So that paſſage in Geneſis, *let there be light, and there was light*, literally ſignifies corporeal light; by an allegory, the Meſſiah; in the tropological ſenſe, grace; and anagogically, beatitude, or the light of glory.

MYSTICS, *myſtici*, a kind of religious ſect, diſtinguiſhed by their profeſſing pure, ſublime, and perfect devotion, with an entire diſintereſted love of God, free from all ſelfiſh conſiderations.

The myſtics, to excuſe their fanatic ecſtacies and amorous extravagancies, alledge that paſſage of St Paul, *The Spirit prays in us by ſighs and groans that are unutterable*. Now if the Spirit, ſay they, pray in us, we muſt reſign ourſelves to its motions, and be ſwayed and guided by its impulſe, by remaining in a ſtate of mere inaction.

Paſſive contemplation is that ſtate of perfection to which the myſtics all aſpire.

The authors of this myſtic ſcience, which ſprung up towards the cloſe of the third century, are not known; but the principles from which it was formed are manifeſt. Its firſt promoters proceeded from the known doctrine of the Platonic ſchool, which was alſo adopted by Origen and his diſciples, that the divine nature was diffuſed through all human ſouls, or that the faculty of reaſon, from which proceed the health and vigour of the mind, was an emanation from God into the human ſoul, and comprehended in it the principles and elements of all truth, human and divine. They denied that men could by labour or ſtudy excite this celeſtial flame in their breaſts; and therefore they diſapproved highly of the attempts of thoſe, who by definitions, abſtract theorems, and profound ſpeculations, endeavoured to form diſtinct notions of truth, and to diſcover its hidden nature. On the contrary, they maintained that ſilence, tranquillity, repoſe, and ſolitude, accompanied with ſuch acts as might tend to extenuate and exhauſt the body, were the means by which the hidden and internal word was excited to produce its latent virtues, and to inſtruct men in the knowledge of divine things. For thus they reaſoned; thoſe who behold with a noble contempt all human affairs, who turn away their eyes from terreſtrial vanities, and ſhut all the avenues of the outward ſenſes againſt the contagious influences of a material world, muſt neceſſarily return to God, when the ſpirit is thus diſengaged from the impediments that prevented that happy union. And in this bleſſed frame they not only enjoy inexpreſſible raptures from their communion with the Supreme Being, but alſo are inveſted with the ineſtimable privilege of contemplating truth undiſguiſed and uncorrupted in its native purity, while others behold it in a vitiated and deluſive form. Myſtics || Mytens.

The number of the myſtics increaſed in the fourth century, under the influence of the Grecian fanatic, who gave himſelf out for Dionyſius the Areopagite, diſciple of St Paul, and probably lived about this period; and by pretending to higher degrees of perfection than other Chriſtians, and practiſing greater auſterity, their cauſe gained ground, eſpecially in the eaſtern provinces, in the fifth century. A copy of the pretended works of Dionyſius was ſent by Balbus to Lewis the Meek in the year 824, which kindled the holy flame of myſticiſm in the weſtern provinces, and filled the Latins with the moſt enthuſiaſtic admiration of this new religion.

In the twelfth century, theſe myſtics took the lead in their method of expounding ſcripture; and by ſearching for myſteries and hidden meaning in the plaineſt expreſſions, forced the word of God into a conformity with their viſionary doctrines, their enthuſiaſtic feelings, and the ſyſtem of diſcipline which they had drawn from the excurſions of their irregular fancies. In the thirteenth century, they were the moſt formidable antagoniſts of the ſchoolmen; and towards the cloſe of the fourteenth, many of them reſided and propagated their tenets almoſt in every part of Europe. They had, in the fifteenth century, many perſons of diſtinguiſhed merit in their number: and in the ſixteenth century, previous to the Reformation, if any ſparks of real piety ſubſiſted under the deſpotic empire of ſuperſtition, they were only to be found among the myſtics.

The principles of this ſect were adopted by thoſe called *Quietiſts* in the ſeventeenth century, and, under different modifications, by the Quakers and Methodiſts.

MYSTRUM, a liquid meaſure among the ancients, containing the fourth part of the Cyathus, and weighing two drams and an half of oil, or two drams two ſcruples of water or wine. It nearly anſwers to our ſpoonful.

MYTELENE. See METYLENE.

MYTENS (Daniel), of the Hague, was an admired painter in the reigns of king James and king Charles. He had certainly (Mr Walpole ſays) ſtudied the works of Rubens before his coming over. His landſcape in the back grounds of his portraits is evidently in the ſtyle of that ſchool; and ſome of his works have been taken for Vandyck's. The date of his arrival is not certain. At Hampton court are ſeveral whole lengths of princes and princeſſes of the houſe of Brunſwick-Lunenburgh, and the portrait of Charles Howard earl of Nottingham; at Kenſington is Mytens's own head. At Knowle, Lionel Cranfield earl of Middleſex, lord treaſurer, with his white ſtaff, whole length. At Lady Elizabeth Germain's at Drayton is a very fine whole length of Henry Rich earl of Holland, in a ſtriped habit, with a walking ſtick. At St James's is Jeffery Hudſon the dwarf, holding a dog by a ſtring, in a landſcape, coloured warmly and freely like Snyder or Rubens. Mytens drew the ſame figure in a very large picture of Charles I. and his

Mytens, Mythology

Queen, which was in the poſſeſſion of the late earl of Dunmore. The picture of the Queen of Scots at St James's is a copy by Mytens. Mytens remained in great reputation till the arrival of Vandyck, who being appointed the king's principal painter, the former in diſguſt aſked his Majeſty's leave to retire to his own country; but the king learning the cauſe of his diſſatisfaction treated him with much kindneſs, and told him that he could find ſufficient employment both for him and Vandyck. Mytens conſented to ſtay, and even grew intimate, it is probable, with his rival, for the head of Mytens is one of thoſe painted among the profeſſors by that great maſter. Whether the ſame jealouſy operated again, or real decline of buſineſs influenced him, or any other cauſe, Mytens did not ſtay much longer in England. We find none of his works here after the year 1630. Yet he lived many years afterwards. Houbraken quotes a regiſter at the Hague dated in 1656, at which time it ſays Mytens painted part of the cieling of the town-hall there; the ſubject is, Truth writing hiſtory on the back of Fame.

MYTENS (Martin), painter of portraits and hiſtory, was born at Stockholm in 1695, and at 11 years of age ſhowed an extraordinary genius. When he had practiſed for ſome years, he determined to ſeek for improvement at Rome, and in his progreſs to examine every thing curious in other cities of Europe. His firſt excurſion was to Holland, and from thence he proceeded to London, where he practiſed miniature and enamel painting, to which he had always a ſtrong tendency, and by his performances in that way gained a ſufficiency to maintain himſelf, without being any incumbrance to his parents. In 1717 he viſited Paris, and proved ſo fortunate as to obtain the favour of the duke of Orleans, and to have the honour to paint the portrait of that prince, and alſo the portraits of Lonis XV. and the Czar Peter. In 1721 he arrived at Vienna, where he was graciouſly received; and having with great applauſe painted the portraits of the emperor, the empreſs, and the moſt illuſtrious perſons at that court, during a reſidence of above two years, he proceeded on his intended journey to Italy. Having viſited Venice, and ſpent two years at Rome, he went to Florence, where the grand duke Gaſton I. ſhowed him all poſſible marks of eſteem; and having engaged him for ſome time in his ſervice, he made him conſiderable preſents, and placed the portrait of Mytens among the heads of the illuſtrious artiſts in his gallery. He alſo received public teſtimonies of favour from the king and queen of Sweden, each of them having preſented him with a chain of gold and a medal, when he viſited that court, after his return from Italy. At laſt he ſettled at Vienna, where he obtained large appointments from the court; and lived univerſally eſteemed for his uncommon merit, and equally valued for his perſonal accompliſhments. He died in 1755.

There were ſome other painters of the name of *Mytens*, but of inferior note.

M Y T H O L O G Y

1 Definition.

IS a term compounded of two Greek words, and in its original import it ſignifies any kind of fabulous doctrine: In its more appropriated ſenſe, it means thoſe fabulous details concerning the objects of worſhip which were invented and propagated by men who lived in the early ages of the world, and by them tranſmitted to ſucceeding generations, either by written records or by oral tradition.

As the theology and mythology of the ancients are almoſt inſeparably connected, it will be impoſſible for us to develope the latter, without often introducing ſome obſervations relating to the former. We muſt therefore intreat the indulgence of our readers, if upon many occaſions we ſhould hazard a few ſtrictures on the names, characters, adventures, and functions of ſuch pagan divinities as may have furniſhed materials for thoſe fabulous narrations which the nature of the ſubject may lead us to diſcuſs.

2 Origin of fable.

With reſpect to *fable*, it may be obſerved in general, that it is a creature of the human imagination, and derives its birth from that love of the *marvellous* which is in a manner congenial to the ſoul of man.—The appearances of nature which every day occur, objects, actions, and events, which ſucceed each other, by a kind of rotine, are too familiar, too obvious, and unintereſting, either to gratify curioſity or to excite admiration. On the other hand, when the moſt common phenomena in nature or life are new-modelled by the plaſtic power of a warm imagination; when they are diverſified, compounded, embelliſhed, or even arranged and moulded into forms which ſeldom or perhaps never occur in the ordinary courſe of things;—novelty generates admiration, a paſſion always attended with delightful ſenſations. Here then we imagine we have diſcovered the very ſource of *fiction* and *fable*.—They originated from that powerful propenſity in our nature towards the *new* and *ſurpriſing*, animated by the delight with which the contemplation of them is generally attended.

Many circumſtances contributed to extend and eſtabliſh the empire of fable. The legiſlator laid hold on this bias of human nature, and of courſe employed *fable* and *fiction* as the moſt effectual means to civilize a rude, unpoliſhed world. The philoſopher, the theologiſt, the poet, the muſician, each in his turn, made uſe of this vehicle to convey his maxims and inſtructions to the ſavage tribes. They knew that *truth*, ſimple and unadorned, is not poſſeſſed of charms powerful enough to captivate the heart of man in his preſent corrupt and degenerate ſtate. This conſideration, which did indeed reſult from the character of their audience, naturally led them to employ fiction and allegory. From this was derived the allegorical taſte of the ancients, and eſpecially of the primary ſages of the eaſt.

Though almoſt every nation on the face of the globe, however remote from the centre of population, however ſavage and averſe from cultivation, has fabricated and

and adopted its own ſyſtem of mythology; the Orientals, however, have diſtinguiſhed themſelves in a peculiar manner, by the boldneſs, the inconſiſtency, and the extravagance of their mythology. The genial warmth of thoſe happy climes, the fertility of the ſoil, which afforded every neceſſary, every convenience, and often every luxury of life, without depreſſing their ſpirits by laborious exertions; the face of nature perpetually blooming around them, the ſkies ſmiling with uninterrupted ſerenity; all contributed to inſpire the orientals with a glow of fancy and a vigour of imagination rarely to be met with in leſs happy regions. Hence every object was ſwelled beyond its natural dimenſions. Nothing was great or little in moderation, but every ſentiment was heightened with incredible hyperbole. The magnificent, the ſublime, the vaſt, the enormous, the marvellous, firſt ſprung up, and were brought to maturity, in thoſe native regions of fable and fairyland. As nature, in the ordinary courſe of her operations, exhibited neither objects nor effects adequate to the extent of their romantic imaginations, they naturally deviated into the fields of fiction and fable. Of conſequence, the cuſtom of detailing fabulous adventures originated in the eaſt, and was from thence tranſplanted into the weſtern countries.

3 Boldneſs of the oriental mythology.

As the allegorical taſte of the eaſtern nations had ſprung from their propenſity to fable, and as that propenſity had in its turn originated from the love of the marvellous; ſo did allegory in proceſs of time contribute its influence towards multiplying fables and fiction almoſt *in infinitum*. The latent import of the allegorical doctrines being in a few ages loſt and obliterated, what was originally a moral or theological tenet, aſſumed the air and habit of a perſonal adventure.

4 Propenſity to perſonification a ſource of eaſtern mythology.

The propenſity towards perſonification, almoſt univerſal among the orientals, was another fruitful ſource of fable and allegory. That the people of the eaſt were ſtrongly inclined to perſonify inanimate objects and abſtract ideas, we imagine will be readily granted, when it is conſidered, that in the formation of language they have generally annexed the affection of ſex to thoſe objects. Hence the diſtinction of grammatical genders, which is known to have originated in the eaſtern parts of the world. The practice of perſonifying virtues, vices, religious and moral affections, was neceſſary to ſupport that allegorical ſtyle which univerſally prevailed in thoſe countries. This mode of writing was in high reputation even in Europe ſome centuries ago; and to it we are indebted for ſome of the moſt noble poetical compoſitions now extant in our own language. Thoſe productions, however, are but faint imitations of the original mode of writing ſtill current among the eaſtern nations. The Europeans derived this ſpecies of compoſition from the Mooriſh inhabitants of Spain, who imported it from Arabia, their original country.

5 The effects of hieroglyphic writing on mythology.

The general uſe of hieroglyphics in the eaſt, muſt have contributed largely towards extending the empire of mythology. As the import of the figures employed in this method of delineating the ſigns of ideas was in a great meaſure arbitrary, miſtakes muſt have been frequently committed in aſcertaining the notions which they were at the firſt intended to repreſent. When the developement of theſe arbitrary ſigns happened to be attended with uncommon difficulty, the expounders were obliged to have recourſe to conjecture. Thoſe conjectural expoſitions were for the moſt part tinctured with that bias towards the marvellous which univerſally prevailed among the primitive men. This we find is the caſe even at this day, when moderns attempt to develope the purport of emblematical figures, preſerved on ancient medals, entaglions, &c.

The wiſe men of the eaſt delighted in obſcure enigmatical ſentences. They ſeem to have diſdained every ſentiment obvious to vulgar apprehenſion. The words of the wiſe, and their dark ſayings, often occur in the moſt ancient records both ſacred and profane. The ſages of antiquity uſed to vie with each other for the prize of ſuperior wiſdom, by propounding riddles, and dark and myſterious queſtions, as ſubjects of inveſtigation. The conteſt between Solomon and Hiram, and that between Amaſis king of Egypt and Polycrates tyrant of Samos, are univerſally known.—As the import of thoſe enigmatical propoſitions was often abſolutely loſt, in ages when the art of writing was little known, and ſtill leſs practiſed, nothing remained but fancy and conjecture, which always verged towards the regions of fable. This then, we think, was another ſource of mythology.

6 Mythology reduced to a kind of ſyſtem in Egypt.

The Pagan prieſts, eſpecially in Egypt, were probably the firſt who reduced mythology to a kind of ſyſtem. The ſacerdotal tribe, among that people, were the grand depoſitories of learning as well as of religion. That order of men monopoliſed all the arts and ſciences. They ſeem to have formed a conſpiracy among themſelves, to preclude the laity from all the avenues of intellectual improvement. This plan was adopted with a view to keep the laity in ſubjection, and to enhance their own importance. To accompliſh this end, they contrived to perform all the miniſtrations of their religion in an unknown tongue, and to cover them with a thick veil of fable and allegory. The language of Ethiopia became their ſacred dialect, and hieroglyphics their ſacred character.—Egypt, of courſe, became a kind of fairyland, where all was jugglery, magic, and enchantment. The initiated alone were admitted to the knowledge of the occult myſtical exhibitions, which, in their hands, conſtituted the eſſence of their religion. From theſe the vulgar and profane were prohibited by the moſt rigorous penalties (ſee MYSTERIES.). The Egyptians, and indeed all the ancients without exception, deemed the myſteries of religion too ſacred and ſolemn to be communicated to the herd of mankind, naked and unreſerved; a mode by which they imagined thoſe ſacred and ſublime oracles would have been defiled and degraded. "Procul, o procul eſte profani—Odi profanum vulgus et arceo." Egypt was the land of graven images; allegory and mythology were the veil which concealed religion from the eyes of the vulgar; fable was the groundwork of that impenetrable covering.

7 In the earlieſt ages of the world mythology had no exiſtence.

In the earlieſt and moſt unpoliſhed ſtage of ſociety we cannot ſuppoſe fable to have exiſted among men. Fables are always *tales of other times*, but at this period other times did not reach far enough backward to afford thoſe fruits of the imagination ſufficient time to arrive at maturity. Fable requires a conſiderable ſpace of time to acquire credibility, and to riſe into reputation. Accordingly, we find that both the Chineſe

6 and

and Egyptians, the two moſt ancient nations whoſe annals have reached our times, were altogether unacquainted with fabulous details in the moſt early and leaſt improved periods of their reſpective monarchies. It has been ſhown almoſt to a demonſtration, by a variety of learned men, that both the one and the other people, during ſome centuries after the general deluge, retained and practiſed the primitive Noachic religion, in which fable and fancy could find no place; all was genuine unſophiſticated truth.

As ſoon as the authentic tradition concerning the origin of the univerſe was either in a good meaſure loſt, or at leaſt adulterated by the inventions of men, fable and fiction began to prevail. The Egyptian *Thoth* or Thyoth, or Mercury Triſmegiſtus, and Mochus the Phœnician, undertook to account for the formation and arrangement of the univerſe, upon principles purely mechanical. Here fable began to uſurp the place of genuine hiſtorical truth. Accordingly, we find that all the hiſtorians of antiquity, who have undertaken to give a general detail of the affairs of the world, have uſhered in their narration with a fabulous coſmogony. Here imagination ranged unconfined over the boundleſs extent of the primary chaos. To be convinced of the truth of this aſſertion, we need only look into Sanchoniathon's Coſmogony, Euſeb. Præp. Evang. l. 1. ſub init. and Diodorus Sic. l. 1. From this we ſuppoſe it will follow, that the firſt race of fables owed their birth to the erroneous opinions of the formation of the univerſe.

8 Fabulous coſmogonies, the firſt mythological details.

Having now endeavoured to point out the origin of mythology, or fabulous traditions, we ſhall proceed to lay before our readers a brief detail of the mythology of the moſt reſpectable nations of antiquity, following the natural order of their ſituation.

9 Chineſe mythology.

The Chineſe, if any credit be due to their own annals, or to the miſſionaries of the church of Rome, who pretend to have copied from them, were *the firſt of the nations*. Their fabulous records reach upwards many myriads of years before the Moſaic æra of the creation. The events during that period of time, if any had been recorded, muſt have been fabulous as the period itſelf. Theſe, however, are buried in eternal oblivion. The miſſionaries, who are the only ſources of our information with relation to the earlieſt periods of the Chineſe hiſtory, repreſent thoſe people as having retained the religion of Noah many centuries after the foundation of their empire. Upon this ſuppoſition, their coſmogony muſt have been ſound and genuine, without the leaſt tincture of thoſe fabulous ingredients which have both diſguiſed and diſgraced the coſmogonies of moſt other nations.

According to the moſt authentic accounts, *Fohe* or *Fohi* laid the foundation of that empire about 4000 years ago. This emperor, according to the Chineſe, was conceived in a miraculous manner. His mother, ſay they, one day as ſhe was walking in a deſert place, was ſurrounded by a rainbow; and, being impregnated by this meteor, was in due time delivered of that celebrated legiſlator. This perſonage, like the Athenian Cecrops, was half a man and half a ſerpent. His intellectual powers were truly hyperbolical. In one day he diſcovered 50 different ſpecies of poiſonous herbs. He taught his countrymen the whole art of agriculture in the ſpace of a very few years. He inſtructed them how to ſow five different ſorts of grain. He invented boats and nets for fiſhing, the art of fabricating porcelain, the management of ſilk-worms, the manufacturing of ſilk, &c. In a word, that wonderful perſonage was inſpired by Heaven with knowledge, which qualified him for compoſing that incomparable body of laws which are even at this day the wonder of the world. Our readers will admit, that this whole detail is fabulous and chimerical. The moſt learned part of them will readily obſerve, that the Chineſe, in aſcribing the invention of all the uſeful arts to their Fohi, are perfectly agreed with almoſt all the other nations of antiquity. The Indians aſcribe every invention to *Budha*, or *Viſhnou*, or *Foe*; the Perſians to *Zerduſht* or *Zoroaſtres*; the Chaldeans to their man of the ſea, whom they call *Oannes*; the Egyptians to *Thoth* or *Thyoth*; the Phœnicians to *Melicerta*; the Greeks to the family of the *Titans*; and the Scandinavians to *Odin*, &c.

10 Birth and inventions of Fohi.

About 551 years before the Chriſtian æra, appeared the famous Chineſe philoſopher *Con-fu-tſe*, or Confucius. Concerning the birth of this prince of philoſophers, the Chineſe have propagated the following legendary tale. His mother walking in a ſolitary place was impregnated by the vivifying influence of the heavens. The babe, thus produced, ſpake and reaſoned as ſoon as it was born. Confucius, however, wrought no miracles, performed no romantic exploits, but lived an auſtere aſcetic life, taught and inculcated the doctrines of pure morality, and died, remarkable only for ſuperior wiſdom, religious, moral, and political.

11 Miraculous birth of Confucius.

About the year of Chriſt 601, flouriſhed the Sectary *Lao-kiun*. His mother carried him 30 years in her womb, and was at laſt delivered of him under a plum-tree. This philoſopher was the Epicurus of the Chineſe. His diſciples, who were denominated *Fao-ſſe*, i. e. heavenly doctors, were the firſt who corrupted the religion of the Chineſe. They were addicted to magic, and introduced the worſhip of good and bad dæmons. Their doctrine was embraced by a long ſucceſſion of emperors. One of theſe princes, called *You-ti*, had been deprived by death of a favourite miſtreſs, whom he loved with the moſt extravagant paſſion. The emperor, by the magical ſkill of one of theſe doctors, obtained an interview with his deceaſed miſtreſs, a circumſtance which rivetted the whole order in the affection and eſteem of the deluded prince. Here our readers will obſerve the exact counterpart of the fable of Eurydice, ſo famous in the mythology of the Greeks and Romans. That ſuch a ſyſtem of religious principles muſt have abounded with mythological adventures is highly probable; but as the miſſionaries, to whom we are chiefly indebted for our information relating to the religion of the Chineſe, have not taken the pains to record them, we find it impoſſible to gratify the curioſity of our readers on that head.

12 Lao-kiun and his doctrines.

The worſhip of the idol Fo, or Foe, was tranſplanted from India into China about the 56th year of the Chriſtian æra, upon the following occaſion. One of the doctors of the Fao-ſſe had promiſed a prince of the family of Tchou, and brother of the emperor Ming-ti, to make him enter into communion with the ſpirits. At his ſolicitation an ambaſſador was diſpatched into India, in order to inquire where the true reli-

13 Introduction of the worſhip of *Fo*, and of the doctrine of the metempſichoſis into China.

gion was to be found. There had been a tradition, ſay the miſſionaries, ever ſince the age of Confucius, that the true religion was to be found in the weſt.—The ambaſſador ſtopt ſhort in India; and finding that the god Foe was in high reputation in that country, he collected ſeveral images of that deity painted on chintz, and with it 42 chapters of the canonical books of the Hindoos, which, together with the images, he laid on a white elephant, and tranſported into his native country. At the ſame time he imported from the ſame quarter the doctrine of the tranſmigration of ſouls, which is firmly believed in China to this day. The doctrine and worſhip of Foe, thus introduced, made a moſt rapid progreſs all over China, Japan, Siam, &c. The prieſts of Foe are called among the Siameſe, *Talopoins*; by the Tartars, *Lamas*; by the Chineſe, *Ho-chang*; and by the people of Japan, *Bonzes*. By this laſt appellation they are generally known in Europe.

14 The worſhippers of Fo great mythologiſts.

An infinitude of fable was invented and propagated by the diſciples of Foe, concerning the life and adventures of their maſter. If the earlier ages of the Chineſe hiſtory are barren of mythological incidents, the later periods, after the introduction of the worſhip of Foe, furniſh an inexhauſtible ſtore of miracles, monſters, fables, intrigues, exploits, and adventures, of the moſt villainous complexion. Indeed, moſt of them are ſo abſurd, ſo ridiculous, and at the ſame time ſo impious and profane, that we are convinced our readers will eaſily diſpenſe with a detail from which they could reap neither entertainment nor inſtruction. Such as may find themſelves diſpoſed to rake into this abominable puddle, we muſt refer to the reverend fathers du Halde, Couplet, Amiot, Kircher, and other members of the propaganda, in whoſe writings they will find wherewithal to ſatisfy, and even to ſurfeit, their appetite.

15 Hindoo mythology.

The Hindoos, like the other nations of the eaſt, for a long time retained the worſhip of the true God. At length, however, idolatry broke in, and, like an impetuous torrent, overwhelmed the country. Firſt of all, the genuine hiſtory of the origin of the univerſe was either utterly loſt, or diſguiſed under a variety of fictions and allegories. We are told that *Brimha*, the ſupreme divinity of the Hindoos, after three ſeveral efforts, at laſt ſucceeded in creating four perſons, whom he appointed to rule over all the inferior creatures.—Afterwards Brimha joined his efficient power with Biſhon and Rulder; and by their united exertions they produced ten men, whoſe general appellation is *Munies*, that is, the inſpired. The ſame being, according to another mythology, produced four other perſons, as imaginary as the former; one from his breaſt, one from his back, one from his lip, and one from his heart. Theſe children were denominated *Bangs;* the import of which word we cannot pretend to determine. According to another tradition, Brimha produced the Bramins from his mouth, to pray, to read, to inſtruct; the Chiltern from his arms, to draw the bow, to fight, to govern; the Bice from his belly or thighs, to nouriſh, to provide the neceſſaries of life by agriculture and commerce; the Soder from his feet, for ſubjection to ſerve, to labour, to travel. The reader will ſee at once, in theſe allegorical perſons, the four caſts or ſepts into which the Hindoo nations has, time immemorial, been divided. Theſe are ſome of their moſt celebrated mythological traditions with relation to the origin of the univerſe.

16 Hindoo traditions relating to the deluge, &c.

The Hindoos have likewiſe ſome mythological opinions which ſeem to relate to the general deluge. They tell us, that deſiring the preſervation of herds and of brahmans, of genii and of virtuous men, of *vedas* of law, and of precious things, the Lord of the univerſe aſſumes many bodily ſhapes; but though he pervades, like the air, a variety of beings, yet he is himſelf unvaried, ſince he has no quality in him ſubject to change. At the cloſe of the laſt *calpa*, there was a general deſtruction, occaſioned by the ſleep of Brahme, whence his creatures in different worlds were drowned in a vaſt ocean. Brahme being inclined to ſlumber after a lapſe of ſo many ages, the ſtrong dæmon *Hayagri-va* came near him, and ſtole the *vedas* which had flowed from his lips. When *Heri*, the preſerver of the univerſe, diſcovered this deed of the prince of *Dainavas*, he took the ſhape of a minute fiſh called *Sap-hari*. After various transformations, and an enormous increaſe of ſize in each of them, the Lord of the univerſe loving the righteous man (A), who had ſtill adhered to him under all theſe various ſhapes, and intending to preſerve him from the ſea of deſtruction cauſed by the depravity of the age, thus told him how he was to act: "In ſeven days from the preſent time, O thou Tamer of enemies! the three worlds will be plunged in an ocean of death; but in the midſt of the deſtroying waves a large veſſel ſent by me for thy uſe ſhall ſtand before thee." The remaining part of the mythology ſo nearly reſembles the Moſaic hiſtory of Noah and the general deluge, that the former may be a ſtrong confirmation of the truth of the latter. To dry up the waters of the deluge, the power of the Deity deſcends in the form of a *boar*, the ſymbol of ſtrength, to draw up and ſupport on his tuſks the whole earth, which had been ſunk beneath the ocean. Again, the ſame power is repreſented as a tortoiſe ſuſtaining the globe, which had been convulſed by the violent aſſaults of dæmons, while the gods charmed the ſea with the mountain *Mandar*, and forced it to diſgorge the ſacred things and animals, together with the water of life which it had ſwallowed. All theſe ſtories, we think, relate to the ſame event, ſhadowed by a moral, a metaphyſical, and an aſtronomical allegory; and all three ſeem connected with the hieroglyphical ſculptures of the old Egyptians.

The Hindoos divide the duration of the world into four *Yugs* or *Jugs*, or *Jogues*, each conſiſting of a prodigious number of years. In each of thoſe periods, the age and ſtature of the human race have been gradually diminiſhed; and in each of them mankind has gradually declined in virtue and piety, as well as in age and ſtature. The preſent period they call the *Colla*, i. e. the corrupt Jogue, which they ſay is to laſt 400,000

(A) He was Sovereign of the world. His name was *Mana*, or Statgavrata; his patronymic name was *Vaiſvata*, or Child of the Sun.

400,000 years, of which near 5000 years are already paſt. In the laſt part of the preceding Jogue, which they call the *Dwa paar*, the age of man was contracted into 1000 years, as in the preſent it is confined to 100. From this proportional diminution of the length of the human life, our readers will probably infer, that the two laſt Jogues bear a pretty near reſemblance to the Moſaic hiſtory of the age of the antediluvian and poſtdiluvian patriarchs; and that the two firſt are imaginary periods prior to the creation of the world, like thoſe of the Chineſe, Chaldeans, and Egyptians.

17 The world ſubject to various diſſolutions and refuſcitations.

According to the mythology of the Hindoos, the ſyſtem of the world is ſubject to various diſſolutions and refuſcitations. At the concluſion of the Collæ Jogue, ſay they, a grand revolution will take place, when the ſolar ſyſtem will be conſumed by fire, and all the elements reduced to their original conſtituent atoms. Upon the back of theſe revolutions, Brimha, the ſupreme deity of the Hindoos, is ſometimes repreſented as a new-born infant, with his toe in his mouth, floating on a camala or water flower, ſometimes only on a leaf of that plant, on the ſurface of the vaſt abyſs. At other times he is figured as coming forth of a winding ſhell; and again as blowing up the mundane foam with a pipe at his mouth. Some of theſe emblematical figures and attitudes, our learned readers will probably obſerve, nearly reſemble thoſe of the ancient Egyptians.

18 Birth, &c. of the god Fo.

But the vulgar religion of the ancient Hindoos was of a very different complection, and opens a large field of mythological adventures. We have obſerved above, that the Fo or Foe of the Chineſe was imported from India; and now we ſhall give a brief detail of the mythological origin of that divinity. We have no certain account of the birth-place of this imaginary deity.—His followers relate, that he was born in one of the kingdoms of India near the line, and that his father was one of that country. His mother brought him into the world by the left ſide, and expired ſoon after her delivery. At the time of her conception, ſhe dreamed that ſhe had ſwallowed a white elephant; a circumſtance which is ſuppoſed to have given birth to the veneration which the kings of India have always ſhown for a white animal of that ſpecies. As ſoon as he was born, he had ſtrength enough to ſtand erect without aſſiſtance. He walked abroad at ſeven, and, pointing with one hand to the heavens, and with the other to the earth, he cried out, "In the heavens, and on the earth, there is no one but me who deſerves to be honoured." At the age of 30, he felt himſelf all on a ſudden filled with the divinity; and now he was metamorphoſed into Fo or Pagod, according to the expreſſion of the Hindoos. He had no ſooner declared himſelf a divinity, than he thought of propagating his doctrine, and proving his divine miſſion by miracles. The number of his diſciples was immenſe; and they ſoon ſpread his dogmas over all India, and even to the higher extremities of Aſia.

19 Doctrines of Fo derived from Egypt.

One of the principal doctrines which Fo and his diſciples propagated, was the metempſychoſis or tranſmigration of ſouls. This doctrine, ſome imagine, has given riſe to the multitude of idols reverenced in every country where the worſhip of Fo is eſtabliſhed. Quadrupeds, birds, reptiles, and the vileſt animals, had temples erected for them; becauſe, ſay they, the ſoul of the god, in his numerous tranſmigrations, may have at one time or other inhabited their bodies.

Both the doctrine of tranſmigration and of the worſhip of animals ſeems, however, to have been imported from Egypt into India. If the intercourſe between theſe two countries was begun at ſo early a period as ſome very late writers have endeavoured to prove, ſuch a ſuppoſition is by no means improbable. The doctrine of the tranſmigration of ſouls was early eſtabliſhed among the Egyptians. It was, indeed, the only idea they formed of the ſoul's immortality. The worſhip of animals among them ſeems to have been ſtill more ancient. If ſuch an intercourſe did actually exiſt, we may naturally ſuppoſe that colonies of Egyptian prieſts found their way into India, as they did afterwards into Aſia Minor, Italy, and Greece. That colonies of Egyptians did actually penetrate into that country, and ſettle there, many centuries before the nativity, is a fact that cannot be called in queſtion, for reaſons which the bounds preſcribed us on this article will not allow us to enumerate. We ſhall only obſerve, that from the hieroglyphical repreſentations of the Egyptian deities ſeem to have originated thoſe monſtrous idols which from time immemorial have been worſhipped in India, China, Japan, Siam, and even in the remoteſt parts of Aſiatic Tartary.

20 The incarnations of Viſhnou.

Foe is often called *Budha*, *Budda*, and ſometimes *Viſhnou*; perhaps, indeed, he may be diſtinguiſhed by many other names, according to the variety of dialects of the different nations among which his worſhip was eſtabliſhed. An infinitude of fables was propagated by his diſciples concerning him after his death. They pretended that their maſter was ſtill alive; that he had been already born 8000 times; and that he had ſucceſſively appeared under the figure of an ape, a lion, a dragon, an elephant, a boar, &c. Theſe were called the incarnations of Viſhnou. At length he was confounded with the ſupreme God; and all the titles, attributes, operations, perfections, and enſigns of the Moſt High were aſcribed to him. Sometimes he is called Amida, and repreſented with the head of a dog, and worſhipped as the guardian of mankind. He ſometimes appears as a princely perſonage, iſſuing from the mouth of a fiſh. At other times, he wears a lunette on his head, in which are ſeen cities, mountains, towers, trees, in ſhort, all that the world contains. Theſe transformations are evidently the children of allegorical or hieroglyphical emblems, and form an exact counterpart to the ſymbolical worſhip of the Egyptians.

The enormous maſs of mythological traditions which have in a manner deluged the vaſt continent of India, would fill many volumes: We have ſelected the preceding articles as a ſpecimen only, by which our readers may be qualified to judge of the reſt. If they find themſelves diſpoſed to indulge their curioſity at greater length, we muſt remit them to Thevenot's and Hamilton's Travels, to Monſ. Aquetil in his Zond. Aveſta, Halhed's Introduction to his tranſlation of the Code of Gentoo Laws, Col. Dow's Hiſtory of Hindoſtan, Groſe's Voyage to the Eaſt Indies, Aſiatic Reſearches, vol. 1. and 2.

21 Perſian mythology.

The mythology of the Perſians is, if poſſible, ſtill more extravagant than that of the Hindoos. It ſuppoſes the world to have been repeatedly deſtroyed, and repeopled by creatures of different formation, who were ſucceſſively annihilated or baniſhed for their diſobedience to the ſupreme Being. The monſtrous griffin *Sinergh* tells the hero *Caherman* that ſhe had already lived to ſee the earth ſeven times filled with creatures and ſeven times a perfect void; that, before the creation of Adam, this globe was inhabited by a race of beings called *Peri* and *Dives*, whoſe character formed a perfect contraſt. The Peri are deſcribed as beautiful and benevolent; the Dives as deformed, malevolent, and miſchievous, differing from infernal demons only in this, that they are not as yet confined to the pit of hell. They are for ever ranging over the world, to ſcatter diſcord and miſery among the ſons of men. The Peri nearly reſemble the fairies of Europe; and perhaps the Dives gave birth to the giants and magicians of the middle ages. The Peri and Dives wage inceſſant wars; and when the Dives make any of the Peri priſoners, they ſhut them up in iron cages, and hang them on the higheſt trees, to expoſe them to public view, and to the fury of every chilling blaſt.

22 *Peri* and *Dives*.

When the Peri are in danger of being overpowered by their foes, they ſolicit the aſſiſtance of ſome mortal hero; which produces a ſeries of mythological adventures, highly ornamental to the ſtrains of the Perſian bards, and which, at the ſame time, furniſhes an inexhauſtible fund of the moſt diverſified machinery.

One of the moſt celebrated adventurers in the mythology of Perſia is *Tahmuras*, one of their moſt ancient monarchs. This prince performs a variety of exploits, while he endeavours to recover the fairy Merjan. He attacks the Dive Demruſh in his own cave; where, having vanquiſhed the giant or demon, he finds vaſt piles of hoarded wealth: theſe he carries off with the fair captive. The battles, labours, and adventures of Roſtan, another Perſian worthy, who lived many ages after the former, are celebrated by the Perſian bards with the ſame extravagance of hyperbole with which the labours of Hercules have been ſung by the poets of Greece and Rome.

23 Perſia the birth-place of chivalry and romance.

The adventures of the Perſian heroes breathe all the wildneſs of atchievement recorded of the knights of Gothic romance. The doctrine of enchantments, transformations, &c. exhibited in both, is a characteriſtic ſymptom of one common original. Perſia is the genuine claſſic ground of eaſtern mythology, and the ſource of the ideas of chivalry and romance; from which they were propagated to the regions of Scandinavia, and indeed to the remoteſt corners of Europe towards the weſt.

Perhaps our readers may be of our opinion, when we offer it as a conjecture, that the tales of the war of the Peri and Dives originated from a vague tradition concerning good and bad angels: nor is it, in our opinion, improbable, that the fable of the wars between the gods and giants, ſo famous in the mythology of Greece and Italy, was imported into the former of theſe countries from the ſame quarter. For a more particular account of the Perſian mythology, our readers may conſult Dr Hyde de Relig. vet. Perſ. Medor. &c. D. Herbelot's Bibl. Orient, and Mr Richardſon's introduction to his Perſian and Arabic Dictionary.

24 Chaldean mythology.

The mythology of the Chaldeans, like that of the other nations of the eaſt, commences at a period myriads of years prior to the æra of the Moſaic creation. Their coſmogony, exhibited by Beroſus, who was a prieſt of Belus, and deeply verſed in the antiquities of his country, is a piece of mythology of the moſt extravagant nature. It has been copied by Euſebius (Chron. l. i. p. 5.); it is likewiſe to be found in Syncellus, copied from Alexander Polyhiſtor. According to this hiſtorian, there were at Babylon written records preſerved with the greateſt care, comprehending a period of fifteen myriads of years. Thoſe writings likewiſe contained a hiſtory of the heavens and the ſea, of the earth, and of the origin of mankind. "In the beginning (ſays Beroſus, copying from Oannes, of whom we ſhall give a brief account below) there was nothing but darkneſs and an abyſs of water, wherein reſided moſt hideous beings produced from a twofold principle. Men appeared with two wings; ſome with two and ſome with four faces. They had one body, but two heads; the one of a man the other of a woman. Other human figures were to be ſeen, furniſhed with the legs and horns of goats. Some had the feet of horſes behind, but before were faſhioned like men, reſembling hippocentaurs." The remaining part of this mythology is much of the ſame complexion; indeed ſo extravagant, that we imagine our readers will readily enough diſpenſe with our tranſlating the ſequel. "Of all theſe (ſays the author) were preſerved delineations in the temple of Belus at Babylon. The perſon who was ſuppoſed to preſide over them was called *Omorea*. This word, in the Chaldean language, is *Thalath*, which the Greeks call θαλασσα, but it more properly imports the moon. Matters being in this ſituation, *their* god (ſays Euſebius), *the* god (ſays Syncellus) came and cut the woman aſunder; and out of one half of her he formed the earth, and out of the other he made the heavens; and, at the ſame time, he deſtroyed the monſters of the abyſs." This whole mythology is an allegorical hiſtory copied from hieroglyphical repreſentations, the real purport of which could not be decyphered by the author. Such, in general, were the conſequences of the hieroglyphical ſtyle of writing.

25 Oannes the legiſlator of the Chaldeans.

Oannes, the great civilizer and legiſlator of the Chaldeans, according to Apollodorus, who copied from Beroſus, was an amphibious animal of a heterogeneous appearance. He was endowed with reaſon and a very uncommon acuteneſs of parts. His whole body reſembled a fiſh. Under the head of a fiſh he had alſo another head, and feet below ſimilar to thoſe of a man, which were ſubjoined to the tail of the fiſh. His voice and language were articulate and perfectly intelligible, and there was a figure of him ſtill extant in the days of Beroſus. He made his appearance in the Erythrean or Red Sea, where it borders upon Babylonia. This monſtrous being converſed with men by day; but at night he plunged into the ſea, and remained concealed in the water till next morning. He taught the Babylonians the uſe of letters and the knowledge of all the arts and ſciences. He inſtructed them in the method of building houſes, conſtructing temples, and all other edifices. He taught them to compile

laws

laws and religious ceremonies, and explained to them the principles of mathematics, geometry, and aſtronomy. In a word, he communicated to them every thing neceſſary, uſeful, and ornamental: and ſo univerſal were his inſtructions, that not one ſingle article had ever been added to them ſince the time they were firſt communicated. Helladius is of opinion that this ſtrange perſonage, whoever he was, came to be repreſented under the figure of a fiſh, not becauſe he was actually believed to be ſuch, but becauſe he was clothed with the ſkin of a ſeal. By this account our readers will ſee that the Babylonian Oannes is the exact counterpart of the Fo hi of the Chineſe, and the Thyoth or Mercury Triſmegiſtus of the Egyptians. It is likewiſe apparent, that the idea of the monſter compounded of the man and the fiſh has originated from ſome hieroglyphic of that form grafted upon the appearance of man. Some modern mythologiſts have been of opinion, that Oannes was actually Noah the great preacher of righteouſneſs; who, as ſome think, ſettled in Shinar or Chaldea after the deluge, and who, in conſequence of his connection with that event, might be properly repreſented under the emblem of *the Man of the Sea*.

26 The nativity of the goddeſs of beauty and love.

The nativity of Venus, the goddeſs of beauty and love, is another piece of mythology famous among the Babylonians and Aſſyrians. An egg, ſay they, of a prodigious ſize, dropt from heaven into the river Euphrates. Some doves ſettled upon this egg, after that the fiſhes had rolled it to the bank. In a ſhort time this egg produced Venus, who was afterwards called the *Dea Syria*, the Syrian goddeſs. In conſequence of this tradition (ſays Hyginus), pigeons and fiſhes became ſacred to this goddeſs among the Syrians, who always abſtained from eating the one or the other. Of this imaginary being we have a very exact and entertaining hiſtory in the treatiſe *De Dea Syria*, generally aſcribed to Lucian.

In this mythological tradition our readers will probably diſcover an alluſion to the celebrated *Mundane egg*; and at the ſame time the ſtory of the fiſhes will lead them to anticipate the connection between the ſea and the moon. This ſame deity was the Atargatis of Aſcalon, deſcribed by Diodorus the Sicilian; the one-half of her body a woman, and the other a fiſh. This was no doubt a hieroglyphic figure of the moon, importing the influence of that planet upon the ſea and the ſex. The oriental name of this deity evidently points to the moon; for it is compounded of two Hebrew words (B), which import "the queen of the hoſt of heaven."

27 The fable of Semiramis.

The fable of Semiramis is nearly connected with the preceding one. Diodorus Siculus has preſerved the mythological hiſtory of this deity, which he and all the writers of antiquity have confounded with the Babylonian princeſs of the ſame name. That hiſtorian informs us, that the word *Semiramis*, in the Syrian dialect, ſignifies "a wild pigeon;" but we apprehend that this term was a name or epithet of the moon, as it is compounded of two words (C) of an import naturally applicable to the lunar planet. It was a general practice among the Orientals to denominate their ſacred animals from that deity to which they were conſecrated. Hence the moon being called *Semiramis*, and the pigeon being ſacred to her divinity, the latter was called by the name of the former.

As the bounds preſcribed this article renders it impoſſible for us to do juſtice to this intereſting piece of mythology, we muſt beg leave to refer our readers for farther information to Diod. Sic. l. ii. Hyginus Poet. Aſtron. fab. 197. Pharnutus de Nat. Deor. Ovid. Metam. l. iv. Athen. in Apol. Izetzes Chil. ix. cap. 275. Seld. de Diis Syr. Syrit. ii. p. 183.

28 Little known of Arabian mythology.

We ſhould now proceed to the mythology of the Arabians, the far greateſt part of which is, however, buried in the abyſs of ages; though, when we reflect on the genius and character of that people, we muſt be convinced that they too, as well as the other nations of the eaſt, abounded in fabulous relations and romantic compoſitions. The natives of that country have always been enthuſiaſtically addicted to poetry, of which fable is the eſſence. Wherever the muſes have erected their throne, fables and miracles have always appeared in their train. In the Koran we meet with frequent alluſions to well-known traditionary fables. Theſe had been tranſmitted from generation to generation by the bards and rhapſodiſts for the entertainment of the vulgar. In Arabia, from the earlieſt ages, it has always been one of the favourite entertainments of the common people, to aſſemble in the ſerene evenings around their tents, or on the platforms with which their houſes are generally covered, or in large halls erected for the purpoſe, in order to amuſe themſelves with traditional narrations of the moſt diſtinguiſhed actions of their moſt remote anceſtors. Oriental imagery always embelliſhed their romantic details. The glow of fancy, the love of the marvellous, the propenſity towards the hyperbolical, and the vaſt, which conſtitute the eſſence of oriental deſcription, muſt ever have drawn the relation aſide into the devious regions of fiction and fairy-land. The religion of Mahomet beat down the original fabric of idolatry and mythology together. The Arabian fables current in modern times are borrowed or imitated from Perſian compoſitions; Perſia being ſtill the grand nurſery of romance in the eaſt.

29 Egyptian mythology.

In Egypt we find idolatry, theology, and mythology, almoſt inſeparably blended together. The inhabitants of this region, too, as well as of others in the vicinity of the centre of population, adhered for ſeveral centuries to the worſhip of the true God. At laſt, however, conſcious of their own ignorance, impurity, imperfection, and total unfitneſs to approach an infinitely perfect Being, diſtant, as they imagined, and inviſible, they began to caſt about for ſome beings more exalted and more perfect than themſelves, by whoſe mediation they might prefer their prayers to the ſupreme Majeſty of heaven. The luminaries of heaven, which they imagined were animated bodies, naturally preſented themſelves. Theſe were ſplendid and glorious beings. They were thought to partake of the divine nature: they were revered as the ſatraps, prefects,

(B) *Adar* or *Hadar*, "*magnificus*;" and *Gad*, "*exercitus turmi*."
(C) *Shem* or *Sem*, "a ſign," and *ramah*, "high."

prefects, and representatives of the ſupreme Lord of the univerſe. They were viſible, they were beneficent; they dwelt nearer to the gods, they were near at hand, and always acceſſible. Theſe were, of courſe, employed as mediators and interceſſors between the ſupreme Divinity and his humble ſubjects of this lower world. Thus employed, they might claim a ſubordinate ſhare of worſhip, which was accordingly aſſigned them. In proceſs of time, however, that worſhip, which was originally addreſſed to the ſupreme Creator by the mediation of the heavenly bodies, was in a great meaſure forgotten, and the adoration of mankind ultimately terminated on thoſe illuſtrious creatures. To this circumſtance, we think, we may aſcribe

30 Origin of Zabiiſm.

the origin of that ſpecies of idolatry called *Zabiiſm*, or the worſhip of the hoſt of heaven, which overſpread the world early and almoſt univerſally. In Egypt this mode of worſhip was adopted in all its moſt abſurd and moſt enthuſiaſtic forms; and at the ſame time the moſt heterogeneous mythology appeared in its train. The mythology of the ancient Egyptians was ſo various and multiform, ſo complicated and ſo myſterious, that it would require many volumes even to give a ſuperficial account of its origin and progreſs, not only in its mother country, but even in many other parts of the eaſtern and weſtern world. Beſides, the idolatry and mythology of that wonderful country are ſo cloſely connected and ſo inſeparably blended together, that it is impoſſible to deſcribe the latter without at the ſame time developing the former. We hope, therefore, our readers will not be diſappointed if, in a work of this nature, we touchonly upon ſome of the leading or moſt intereſting articles of this complicated ſubject.

31 Reign of gods and demigods, &c. in Egypt.

The Egyptians confounded the revolutions of the heavenly bodies with the reigns of their moſt early monarchs. Hence the incredible number of years included in the reign of their eight ſuperior gods, who, according to them, filled the Egyptian throne ſucceſſively in the moſt early periods of time. To theſe, according to their ſyſtem, ſucceeded twelve demigods, who likewiſe reigned an amazing number of years. Theſe imaginary reigns were no other than the periodical revolutions of the heavenly bodies preſerved in their almanacks, which might be carried back, and actually were carried back, at pleaſure. Hence the fabulous antiquity of that kingdom. The imaginary exploits and adventures of theſe gods and demigods furniſhed an inexhauſtible fund of mythological romances. To the demigods ſucceeded the kings of the cynic cycle, perſonages equally chimerical with the former. The import of this epithet has greatly perplexed critics and etymologiſts. We apprehend it is an oriental word importing *royal* dignity, elevation of rank. This appellation intimated, that the monarchs of that cycle, admitting that they actually exiſted, were more powerful and more highly revered than their ſucceſſors. After the princes of the cynic cycle comes another race, denominated *Nekyes*, a title likewiſe implying royal, ſplendid, glorious. Theſe cycles figure high in the mythological annals of the Egyptians, and have furniſhed materials for a variety of learned and ingenious diſquiſitions. The wars and

32 Birth, exploits, and tranſformation of the gods.

adventures of Oſiris, Orus, Typhon, and other allegorical perſonages who figure in the Egyptian rubric; the wanderings of Iſis, the ſiſter and wife of Oſiris; the transformation of the gods into divers kinds of animals; their birth, education, peregrinations, and exploits;—compoſe a body of mythological fictions ſo various, ſo complicated, ſo ridiculous, and often ſo apparently abſurd, that all attempts to develope and explain them have hitherto proved unſucceſsful. All, or the greateſt part, of thoſe extravagant fables, are the offſpring of hieroglyphical or allegorical emblems deviſed by the prieſts and ſages of that nation, with a view to conceal the myſteries of their religion from that claſs of men whom they ſtigmatized with the name of the uninitiated rabble.

33 Worſhip of brute animals, &c.

The worſhip of brute animals and of certain vegetables univerſal among the Egyptians, was another exuberant ſource of mythological adventures. The Egyptian prieſts, many of whom were likewiſe profound philoſophers, obſerved, or pretended to obſerve, a kind of analogy between the qualities of certain animals and vegetables, and thoſe of ſome of their ſubordinate divinities. Such animals and vegetables they adopted, and conſecrated to the deities to whom they were ſuppoſed to bear this analogical reſemblance; and in proceſs of time they conſidered them as the viſible emblems of thoſe divinities to which they were conſecrated. By theſe the vulgar addreſſed their archetypes: in the ſame manner, as in other countries, pictures and ſtatues were employed for the very ſame purpoſe. The mob, in proceſs of time, forgetting the emblematical character of thoſe brutes and vegetables, addreſſed their devotion immediately to them; and of courſe theſe became the ultimate objects of vulgar adoration.

After that theſe objects, animate or inanimate, were conſecrated as the viſible ſymbols of the deities, it ſoon became faſhionable to make uſe of their figures to repreſent thoſe deities to which they were conſecrated. This practice was the natural conſequence of the hieroglyphical ſtyle which univerſally prevailed among the ancient Egyptians. Hence Jupiter Ammon was repreſented under the figure of a ram, Apis under that of a cow, Oſiris of a bull, Pan of a goat, Thoth or Mercury of an ibis, Bubaſtis or Diana of a cat, &c. It was likewiſe a common practice among thoſe deluded people to dignify theſe objects, by giving them the names of thoſe deities which they repreſented. By this mode of dignifying theſe ſacred emblems, the veneration of the rabble was conſiderably enhanced, and the ardour of their devotion inflamed in proportion. From theſe two ſources, we think, are derived the fabulous tranſformations of the gods, ſo generally celebrated in the Egyptian mythology, and from it imported into Greece and Italy. In conſequence of this practice, their mythological ſyſtem was rendered at once enormous and unintelligible.

34 Mercury Triſmegiſtus the author of the Egyptian mythology.

Their Thoth, or Mercury Triſmegiſtus, was, in our opinion, the inventor of this unhappy ſyſtem. This perſonage, according to the Egyptians, was the original author of letters, geometry, aſtronomy, muſic, architecture; in a word, of all the elegant and uſeful arts, and of all the branches of ſcience and philoſophy. He it was who firſt diſcovered the analogy between the divine affections, influences, appearances, operations, and the correſponding properties, qualities, and inſtincts

inſtincts of certain animals, and the propriety of dedicating particular kinds of vegetables to the ſervice of particular deities.

The prieſts, whoſe province it was to expound the myſteries of that allegorical hieroglyphical religion, (ſee MYSTERIES), gradually loſt all knowledge of the primary import of the ſymbolical characters. To ſupply this defect, and at the ſame time to veil their own ignorance, the ſacerdotal inſtructors had recourſe to fable and fiction. They heaped fable upon fable, till their religion became an accumulated chaos of mythological abſurdities.

Two of the moſt learned and moſt acute of the ancient philoſophers have attempted a rational explication of the latent import of the Egyptian mythology; but both have failed in the attempt; nor have the moderns, who have laboured in the ſame department, performed their part with much better ſucceſs. Inſtead, therefore, of proſecuting this inexplicable ſubject, which would ſwell this article beyond all proportion, we muſt beg leave to refer thoſe who are deſirous of further information to the following authors, where they will find enough to gratify their curioſity, if not to inform their judgment: Herodotus, lib. ii. Diodorus Siculus, lib. i. Plut. Iſis and Oſiris; Jamblichus de Myſt. Egypt. Horapollo Hieroglyp. Egypt. Macrob. Sat. cap. 23. among the ancients: and among the moderns, Kircher's Oedip. Voſſ. de orig. et prog. Idol. Mr Bryant's Analyſis of Anc. Mythol. Monſ. Gebelin Monde prim.; and above all, to the learned Jablonſki's Panth. Egyptiorum.

35 Phœnician mythology

The elements of Phœnician mythology have been preſerved by Euſebius, Præp. Evang. ſub init. In the large extract which that learned father hath copied from Philo Biblius's tranſlation of Sanchoniatho's Hiſtory of Phœnicia, we are furniſhed with ſeveral articles of mythology. Some of theſe throw conſiderable light on ſeveral paſſages of the ſacred hiſtory; and all of them are ſtrictly connected with the mythology of the Greeks and Romans. There we have preſerved a brief but entertaining detail of the fabulous adventures of Uranus, Cronus, Dagon, Thyoth or Mercury, probably the ſame with the Egyptian hero of that name. Here we find Muth or Pluto, Æphceſtus or Vulcan, Æſculapius, Nereus, Poſcedon or Neptune, &c. Aſtarte, or Venus Urania, makes a conſpicuous figure in the catalogue of Phœnician worthies; Pallas or Minerva is planted on the territory of Attica; in a word, all the branches of the family of the Titans, who in after ages figured in the rubric of the Greeks, are brought upon the ſtage, and their exploits and adventures briefly detailed.

36 Grecian mythology derived from Egypt and Phœnicia;

By comparing this fragment with the mythology of the Atlantidæ and that of the Cretans preſerved by Diodorus the Sicilian, lib. v. we think there is good reaſon to conclude, that the family of the Titans, the ſeveral branches of which ſeem to have been both the authors and objects of a great part of the Grecian idolatry, originally emigrated from Phœnicia. This conjecture will receive additional ſtrength, when it is conſidered, that almoſt all their names recorded in the fabulous records of Greece, may be eaſily traced up to a Phœnician original. We agree with Herodotus, that a conſiderable part of the idolatry of Greece may have been borrowed from the Egyptians; at the ſame time, we imagine it highly probable, that the idolatry of the Egyptians and Phœnicians were, in their original conſtitution, nearly the ſame. Both ſyſtems were Sabiiſm, or the worſhip of the hoſt of heaven. The Pelaſgi, according to Herodotus, learned the names of the gods from the Egyptians; but in this conjecture he is certainly warped by his partiality for that people. Had thoſe names been imported from Egypt, they would no doubt have bewrayed their Egyptian original; whereas, every etymologiſt will be convinced that every one is of Phœnician extraction.

The adventures of Jupiter, Juno, Mercury, Apollo, Diana, Mars, Minerva or Pallas, Venus, Bacchus, Ceres, Proſerpine, Pluto, Neptune, and the other deſcendants and coadjutors of the ambitious family of the Titans, furniſh by far the greateſt part of the mythothology of Greece. They left Phœnicia, we think, about the age of Moſes; they ſettled in Crete, a large and fertile iſland; from this region they made their way into Greece, which, according to the moſt authentic accounts, was at that time inhabited by a race of ſavages. The arts and inventions which they communicated to the natives; the myſteries of religion which they inculcated; the laws, cuſtoms, polity, and good order, which they eſtabliſhed; in ſhort, the bleſſings of humanity and civilization, which they everywhere diſſeminated, in proceſs of time inſpired the unpoliſhed inhabitants with a kind of divine admiration. Thoſe ambitious mortals improved this admiration into divine homage and adoration. The greater part of that worſhip, which had been formerly addreſſed to the luminaries of heaven, was now transferred to thoſe illuſtrious perſonages. They claimed and obtained divine honours from the deluded rabble of enthuſiaſtic Greeks. Hence ſprung an inexhauſtible fund of the moſt inconſiſtent and irreconcileable fictions.

37 Hence the inconſiſtent fictions of the Greek poets.

The foibles and frailties of the deified mortals were tranſmitted to poſterity, incorporated as it were with the pompous attributes of ſupreme divinity. Hence the heterogeneous mixture of the mighty and the mean which chequers the characters of the heroes of the Iliad and Odyſſey. The Greeks adopted the oriental fables; the import of which they did not underſtand. Theſe they accommodated to heroes and illuſtrious perſonages, who had figured in their own country in the earlieſt periods. The labours of Hercules originated in Egypt, and evidently relate to the annual progreſs of the ſun in the zodiac, though the vain-glorious Greeks accommodated them to a hero of their own, the reputed ſon of Jupiter and Alcmena. The expedition of Oſiris they borrowed from the Egyptians, and transferred to their Bacchus, the ſon of Jupiter and Semele the daughter of Cadmus. The transformation and wanderings of Io are evidently tranſcribed from the Egyptian romance of the travels of Iſis in queſt of the body of Oſiris, or of the Phœnician Aſtarte, drawn from Sanchoniathon. *Io* or *Ioh* is in reality the Egyptian name of the moon, and Aſtarte was the name of the ſame planet among the Phœnicians. Both theſe fables are allegorical repreſentations of the anomalies of the lunar planet, or perhaps of the progreſs of the worſhip of that planet in different parts of the world. The fable of the conflagration occaſioned by Phaethon is clearly of oriental extraction, and alludes to an exceſſive drought which in the early

periods of time ſcorched Ethiopia and the adjacent countries. The fabulous adventures of Perſeus are ſaid to have happened in the ſame regions, and are allegorical repreſentations of the influence of the ſolar luminary; for the original Perſeus was the ſun. The rape of Proſerpine and the wanderings of Ceres: the Eleuſinian myſteries; the orgia or ſacred rites of Bacchus; the rites and worſhip of the Cabiri—were imported from Egypt and Phœnicia; but ſtrangely garbled and diſfigured by the Hierophants of Greece. The gigantomachia, or war between the gods and the giants, and all the fabulous events and varieties of that war, form an exact counterpart to the battles of the Peri and Dives, celebrated in the romantic annals of Perſia.

38 The Greeks ignorant of oriental languages.

A conſiderable part of the mythology of the Greeks ſprung from their ignorance of the oriental languages. They diſdained to apply themſelves to the ſtudy of languages ſpoken by people whom, in the pride of their heart, they ſtigmatiſed with the epithet of *barbarians*. This averſion to every foreign dialect was highly detrimental to their progreſs in the ſciences. The ſame neglect or averſion has, we imagine, proved an irreparable injury to the republic of letters in all ſucceeding ages. The aoids or ſtrolling bards laid hold on thoſe oriental legends, which they ſophiſticated with their own additions and improvements, in order to accommodate them to the popular taſte. Theſe wonderful tales figured in their rhapſodical compoſitions, and were greedily ſwallowed down by the credulous vulgar. Thoſe fictions, as they rolled down, were conſtantly augmented with freſh materials, till in proceſs of time their original import was either forgotten or buried in impenetrable darkneſs. A multitude of theſe Heſiod has collected in his Theogonia, or generation of the gods, which unhappily became the religious creed of the illiterate part of the Greeks. Indeed, fable was ſo cloſely interwoven with the religion of that airy volatile people, that it ſeems to have contaminated not only their religious and moral, but even their political tenets.

39 Oracle of Dodona.

The far-famed oracle of Dodona was copied from that of Ammon of Thebes in Egypt: The oracle of Apollo at Delphos was an emanation from the ſame ſource: The celebrated Apollo Pythius of the Greeks was no other than *Ob* or *Aub* of the Egyptians, who denominated the baſiliſk or royal ſnake *Ov Cai*, becauſe it was held ſacred to the ſun. *Ob* or *Aub* is ſtill retained in the Coptic dialect, and is one of the many names or epithets of that luminary. In ſhort, the ground-work of the Grecian mythology is to be traced in the eaſt. Only a ſmall part of it was fabricated in the country; and what was imported pure and genuine was miſerably ſophiſticated by the hands through which it paſſed, in order to give it a Grecian air, and to accommodate its ſtyle to the Grecian taſte. To enlarge upon this topic would be altogether ſuperfluous, as our learned readers muſt be well acquainted with it already, and the unlearned may without much trouble or expence furniſh themſelves with books upon that ſubject.

[39] Roman mythology borrowed from Greece.

The Roman mythology was borrowed from the Greeks. That people had addicted themſelves for many centuries to the arts of war and civil polity. Science and philoſophy were either neglected or unknown. At laſt they conquered Greece, the native land of ſcience, and then "Græcia capta ferum victorem cepit arte et intulit agreſti Latio." This being the caſe, their mythology was, upon the whole, a tranſcript from that of Greece. They had indeed gleaned a few fables from the Pelaſgi and Hetruſcans, which, however, are of ſo little conſequence, that they are ſcarce worth the trouble of tranſcribing.

The mythology of the Celtic nations is in a good meaſure loſt. There may poſſibly ſtill remain ſome veſtiges of the Druidical ſuperſtition in the remoteſt parts of the Highlands and iſlands of Scotland; and perhaps in the uncivilized places of Ireland. Theſe, we preſume, would afford our readers but little entertainment, and ſtill leſs inſtruction. Inſtead therefore of giving a detail of thoſe unintereſting articles, we ſhall beg leave to refer our readers to Oſſian's Poems, and Col. Valency's Collections of Iriſh Antiquities, for ſatisfaction on that ſubject.

40 Mythology of the northern nations.

The mythology of the northern nations, *i. e.* of the Norwegians, Danes, Swedes, Icelanders, &c. are uncommonly curious and entertaining. The Edda and Voluſpa contain a complete collection of fables which have not the ſmalleſt affinity with thoſe of the Greeks and Romans. They are wholly of an oriental complexion, and ſeem almoſt congenial with the tales of the Perſians above deſcribed. The Edda was compiled in Iceland in the 13th century. It is a kind of ſyſtem of the Scandinavian mythology; and has been reckoned, and we believe juſtly, a commentary on the Voluſpa, which was the Bible of the northern nations. Odin or Othin, or Woden or Waden, was the ſupreme divinity of thoſe people. His exploits and adventures furniſh the far greateſt part of their mythological creed. That hero is ſuppoſed to have emigrated from the eaſt; but from what country or at what period is not certainly known. His atchievements are magnified beyond all credibility. He is repreſented as the god of battles, and as ſlaughtering thouſands at a blow. His palace is called *Valhal:* it is ſituated in the city of Midgard, where, according to the fable, the ſouls of heroes who had bravely fallen in battle enjoy ſupreme felicity. They ſpend the day in mimic hunting-matches, or imaginary combats. At night they aſſemble in the palace of Valhalla, where they feaſt on the moſt delicious viands, dreſſed and ſerved up by the *Valkyriæ*, virgins adorned with celeſtial charms, and fluſhed with the bloom of everlaſting youth. They ſolace themſelves with drinking mead out of the ſkulls of enemies whom they killed in their days of nature. Mead, it ſeems, was the nectar of the Scandinavian heroes.

41 Odin or Woden.

Sleepner, the horſe of Odin, is celebrated along with his maſter. Hela, the hell of the Scandinavians, affords a variety of fables equally ſhocking and heterogeneous. Loke, the evil genius or devil of the northern people, nearly reſembles the Typhon of the Egyptians. Signa or Sinna is the conſort of Loke; from this name the Engliſh word *ſin* is derived. The giants Weymur, Ferbanter, Belupher, and Hellunda, perform a variety of exploits, and are exhibited in the moſt frightful attitudes. One would be tempted to imagine, that they perform the exact counterpart of the giants of the Greek and Roman mythologiſts. Inſtead of glancing at theſe ridiculous and unintereſting

42 The hell and devil of the Scandinavians.

fables, which is all that the limits preſcribed us would permit, we ſhall take the liberty to lay before our readers a brief account of the contents of the Voluſpa, which is indeed the text of the Scandinavian mythology.

43 The Voluſpa.

The word *Voluſpa* imports, "the prophecy of Vola or Fola." This was perhaps a general name for the prophetic ladies of the north, as Sybil was appropriated to women endowed with the like faculty in the ſouth. Certain it is, that the ancients generally connected madneſs with the prophetic faculty. Of this we have two celebrated examples: the one in Lycophron's Alexandra, and the other in the Sybil of the Roman Poet. The word *vola* ſignifies "mad or fooliſh;" whence the Engliſh words *fool*, *fooliſh*, *folly*. *Spa*, the latter part of the compoſition, ſignifies "to prophecy," and is ſtill current among the common people in Scotland, in the word *Spæ*, which has nearly the ſame ſignification.

The Voluſpa conſiſts of between 200 and 300 lines. The propheteſs having impoſed ſilence on all intelligent beings, declares that ſhe is about to reveal the works of the Father of nature, the actions and operations of the gods, which no mortal ever knew before herſelf. She then begins with a deſcription of the chaos; and then proceeds to the formation of the world, the creation of the different ſpecies of its inhabitants, giants, men, and dwarfs. She then explains the employments of the fairies or deſtinies, whom the northern people call *nornies*; the functions of the deities, their moſt memorable adventures, their diſputes with Loke, and the vengeance that enſued. She at laſt concludes with a long and indeed animated deſcription of the final ſtate of the univerſe, and its diſſolution by a general conflagration.

In this cataſtrophe, Odin and all the rabble of the pagan divinities, are to be confounded in the general ruin, no more to appear on the ſtage of the univerſe. Out of the ruins of the former world, according to the Voluſpa, a new one ſhall ſpring up, arrayed in all the bloom of celeſtial beauty.

Such is the doctrine exhibited in the fabulous Voluſpa. So congenial are ſome of the details therein delivered, eſpecially their relating to the final diſſolution of the preſent ſyſtem, and the ſucceſſion of a new heaven and a new earth, that we find ourſelves ſtrongly inclined to ſuſpect, that the original fabrication of the work was a ſemipagan writer, much of the ſame complexion with the authors of the Sybilline oracles, and of ſome other apocryphal pieces which appeared in the world during the firſt ages of Chriſtianity.

44 Mythology of Mexico and Peru.

In America, the only mythological countries muſt be Mexico and Peru. The other parts of that large continent were originally inhabited by ſavages, moſt of them as remote from religion as from civilization. The two vaſt empires of Mexico and Peru had exiſted about 400 years only before the Spaniſh invaſion. In neither of them was the uſe of letters underſtood; and of courſe the ancient opinions of the natives relating to the origin of the univerſe, the changes which ſucceeded, and every other monument of antiquity, was obliterated and loſt. Clavigero has indeed enumerated a vaſt canaille of ſanguinary gods worſhipped by the Mexicans; but produces nothing either entertaining or intereſting with reſpect to their mythology. The information to be derived from any other quarter is little to be depended upon. It paſſes through the hands of bigoted miſſionaries or other eccleſiaſtics, who were ſo deeply tinctured with fanaticiſm, that they viewed every action, every ſentiment, every cuſtom, every religious opinion and ceremony of thoſe half-civilized people, through a falſe medium. They often imagined they diſcovered reſemblances and analogies between the rites of thoſe ſavages and the dogmas of Chriſtianity, which no where exiſted but in their own heated imagination.

The only remarkable piece of mythology in the annals of the Peruvians, is the pretended extraction of Manco Cape the firſt Inca of Peru, and of Mama Ocolla his conſort. Theſe two illuſtrious perſonages appeared firſt on the banks of the lake Titiaca. They were perſons of a majeſtic ſtature, and clothed in decent garments. They declared themſelves to be the children of the Sun, ſent by their beneficent parent, who beheld with pity the miſeries of the human race, to inſtruct and to reclaim them. Thus we find theſe two legiſlators availed themſelves of a pretence which had often been employed in more civilized regions to the very ſame purpoſes. The idolatry of Peru was gentle and beneficent, that of Mexico gloomy and ſanguinary. Hence we may ſee, that every mode of ſuperſtition, where a divine revelation is not concerned, borrows its complexion from the characters of its profeſſors.

In the courſe of this article, our readers will obſerve, that we have not much enlarged upon the mythology of the Greeks and Romans; that ſubject, we imagine to be ſo univerſally known by the learned, and ſo little valued by the vulgar, that a minute diſcuſſion of it would be altogether ſuperfluous. Beſides, we hope it will be remembered, that the narrowneſs of the limits preſcribed us would ſcarce admit of a more copious detail. We would flatter ourſelves, that in the courſe of our diſquiſition, we have thrown out a few reflections and obſervations, which may perhaps prove more acceptable to both deſcriptions of readers.

Mytilus. MYTILUS, the Mussel, in ichthyology; a genus of animals, belonging to the order of vermes teſtacea. The animal is an aſcidia: the ſhell bivalve; often affixed to ſome ſubſtance by a beard; the hinge without a tooth, marked by a longitudinal hollow line. Of theſe animals there are a great many ſpecies, ſome of them inhabiting the ſeas, others the rivers and ponds. Several of them are remarkable for the beauty of their internal ſhell, and for the pearls which are ſometimes found in them. Mytilus.

1. The edulis, or edible muſſel, has a ſtrong ſhell, ſlightly incurvated on one ſide, and angulated on the other.

Mytilus.

other. The end near the hinge is pointed: the other rounded. When the epidermis is taken off, it is of a deep blue colour. It is found in immenſe beds, both in deep water and above low-water mark. The fineſt muſſels in Britain are thoſe called *Hambleton hookers*, from a village called *Hambleton* in that county. They are taken out of the ſea, and placed in the river Wier, within reach of the tide, where they grow very fat and delicious. This ſpecies inhabits the European and Indian ſeas. Between the tropics it is largeſt, and ſmalleſt within the polar circle. It is ſaid to be hurtful if too often eat, or in too great quantities; and is even ſometimes poiſonous.

2. The modiolus, or great muſſel, with a ſtrong ſhell, blunted at the upper end; one ſide angulated near the middle; from thence dilating towards the end, which is rounded. It dwells in the Mediterranean, Indian, European, and American ſeas; and its fleſh, which is a deep orange colour, is eatable. It is the greateſt of the muſſels known in Britain; being from ſix to ſeven inches in length; it lies at great depths; often ſeizes the baits of ground-lines, and is taken up with the hooks.

3. The cygneus, or ſwan muſſel, with a thin brittle ſhell, very broad and convex, marked with concentric ſtriæ; attenuated towards one end, dilated towards the other; decorticated about the hinge; the colour a dull green; the length ſix inches, breadth three and a half. It is an inhabitant of the European rivers, frequenting chiefly their mouths.

4. The anatinus, or duck muſſel, has a ſhell more oblong and leſs convex than the laſt; is very brittle and ſemitranſparent; the ſpace round the hinges like the laſt; the length about five inches, breadth two. It is found in Europe in freſh waters. Both it and the cygneus are devoured by ſwans and ducks; whence their names: crows alſo feed on theſe muſſels, as well as on different other ſhell fiſh; and it is diverting to obſerve, that when the ſhell is too hard for their bills, they fly with it to a great height, drop the ſhell on a rock, and pick out the meat when the ſhell is fractured by the fall.

5. The cryſtagalli, or cock's-comb muſſel, has the ſhell folded or plaited as it were, ſpiny, and both lips rugged. It makes its abode in the coral beds of the Indian ocean.

6. The margaritiferus, or pearl-bearing muſſel, has the ſhell compreſſed and flat, nearly orbicular, the baſe tranſverſe, and imbricated with dentated coats. It dwells in the ocean of either India. This is the *mater perlarum* of Rumphius, or mother-of-pearl ſhell. On the inſide it is exquiſitely poliſhed, and of the whiteneſs and water of pearl itſelf. It has alſo the ſame luſtre on the outſide after the external laminæ have been taken off by aquafortis and the lapidary's mill. Mother-of-pearl is uſed in inlaid works, and in ſeveral toys, as ſnuff-boxes, &c. Mytilus.

7. The lithophagus, or ſtone-eating muſſel, has the ſhell cylindric, the extremities both ways being rounded. It inhabits the Indian, European, and Mediterranean ſeas, penetrating and eating away marbles, corals, &c. The Indian ſhell is ſofter and nearly tough like leather, but the European is more brittle.

8. The violacea, or violet muſſel, has the ſhell longitudinally furrowed, the rim very obtuſe, ſomewhat formed like the mytilus edulis, but conſiderably larger and more flattened, of a beautiful violet colour. Inhabits the ſouthern ocean. There are about 50 other ſpecies.

Muſſels not only open and ſhut their ſhells at pleaſure, but they have alſo a progreſſive motion; they can faſten themſelves where they pleaſe; they reſpire water like the fiſhes; and ſome even flutter about on its ſurface ſo as to inhale air. If they lie in ſhallow places, a ſmall circular motion is ſeen above the heel of the ſhell; and a few moments after, they caſt out the water by one ſingle ſtroke at the other end of the ſhell. The mouth is ſituated near the ſharp angle of the animal, and is furniſhed with four floating fringes in the ſhape of muſtachios, which may perhaps anſwer the purpoſe of lips. The barbs which ſurround the edge of almoſt half the muſſel, are a wonderful web of hollow fibres which ſerve as fins or organs of reſpiration, as veſſels for the circulation of the fluids, and probably, as ſome philoſophers ſuppoſe, as wedges for opening their ſhells; for we obſerve two large muſcles or tendons for the purpoſe of ſhutting them; but we in vain look for their antagoniſts, or thoſe which are deſtined to open them. When the muſſel wiſhes to open itſelf, it relaxes the two muſcles or tendons, and ſwells the fringes, which act as wedges and ſeparate the ſhells. The animal ſhuts up itſelf by the contraction of two thick fibrous muſcles which are fixed internally to each end of the ſhells; and theſe ſhells are lined all around with a membrane or epidermis, which unites them ſo cloſely together when they are ſoaked in water, that not the ſmalleſt drop can eſcape from the muſcle. When muſſels chooſe to walk (A), they often contrive to raiſe themſelves on the ſharp edge of their ſhells, and put forth a fleſhy ſubſtance ſuſceptible of extenſion, which ſerves them as a leg to drag themſelves along, in a kind of groove or furrow which they form in the ſand or mud, and which ſupports the ſhell on both ſides. In ponds, theſe furrows are very obſervable. From the ſame member or leg hang the threads

(A) The common ſea or edible muſſel has, from its being for the moſt part found faſtened to the rocks, been ſuppoſed by many wholly incapable of progreſſive motion; but this M. Reamur has ſhown to be an erroneous opinion. It is a common practice in France, at ſuch ſeaſons of the year as do not afford ſun enough to make ſalt, to throw the common ſea-muſſels, which the fiſhermen catch about the coaſts, into the brine-pits. They have an opinion that this renders their fleſh the more tender and delicate, as the rain which falls at theſe ſeaſons makes the water of the pits much leſs ſalt than the common ſea-water. The muſſels are on this occaſion thrown careleſsly in, in ſeveral different parts of the pits; yet, at whatever diſtances they have been thrown in, the fiſhermen, when they go to take them out, always find them in a cluſter together; and as there is no current of water in theſe places, nor any other power of motion which can have brought the muſſels together, it ſeems

Mytilus. threads by which the animals faſten (B) themſelves to rocks or to one another.

According to the obſervations of M. Mery of the Paris Academy, and the ſubſequent experiments of other naturaliſts, muſſels are all androgynous; and, from a peculiar generative organization, each individual is of itſelf capable of propagating its ſpecies, and annually does it without the intercourſe of any other. This is altogether ſingular, and different from what takes place in ſnails, earth-worms, and other hydrogenous or hermaphroditical animals; for though each individual of theſe contains the parts of both ſexes, yet there is always a congreſs of two animals for the propagation of the ſpecies. The parts of generation are Mytilus.

ſeems very evident that they muſt voluntarily have marched from the places where they were at firſt, to have met thus together. This progreſſive motion is wholly performed by means of what we call the *tongue* of the muſſel, from its ſhape; but, from its uſe in this caſe, appears rather to merit the name of a *leg*, or an *arm*, as by laying hold of any diſtant ſubſtance, and then forcibly contracting itſelf again, it draws along the whole body of the animal. The ſame part, when it has moved the animal to a proper place, ſerves alſo to fix it there, being the organ by which it ſpins the threads which we call its *beard*, by which it is held to a rock, or to another muſſel. The motion of the muſſel, by means of this part, is juſt the ſame with that of a man laid flat on his belly, who would draw himſelf along by laying hold of any thing with one hand, and then drawing himſelf to it.

(B) Muſſels are well known to have a power of faſtening themſelves either to ſtones, or to one another's ſhells, in a very ſtrong and firm manner; but the method of doing this was not well underſtood till the obſervations of Mr Reaumur explained it. Every one who opens and examines a common muſſel, will find, that in the middle of the fiſh there is placed a little blackiſh or browniſh body reſembling a tongue. This in large muſſels is near half an inch long, and a little more than a ſixth of an inch in breadth, and is narrower at the origin than at the extremity: from the root of this tongue, or that part of it which is faſtened to the body of the fiſh, there are produced a great number of threads, which, when fixed to any ſolid ſubſtance, hold the muſſel firmly in its place: theſe threads are uſually from an inch to two inches in length, and in thickneſs from that of a hair to that of a hog's briſtle. They iſſue out of the ſhell in that part where it naturally opens, and fix themſelves to any thing that lies in their way, to ſtones, to fragments of ſhells, or, which is the moſt common caſe, to the ſhells of other muſſels; whence it happens that there are uſually ſuch large quantities of muſſels found together. Theſe threads are expanded on every ſide, and are uſually very numerous, 150 having been found iſſuing from one ſhell: they ſerve the office of ſo many cables; and, each pulling in its proper direction, they keep the muſſel fixed againſt any force that can be offered from whatever part it come. The filaments are well known to all who eat muſſels, who ever carefully ſeparate them under the name of the *beard*; and Mr Reaumur has found, that while the animal is living in the ſea, if they are all torn away by any accident, the creature has a power of ſubſtituting others in their room: he found, that if a quantity of muſſels were detached from one another and put into a veſſel of any kind, and in that plunged into the ſea, they in a little time faſtened themſelves both to the ſides of the veſſel and to one another's ſhells; the extremity of each thread ſeemed in this caſe to ſerve in the manner of a hand to ſeize upon any thing that it would fix to, and the other part, which was ſlenderer and ſmaller, to do the office of an arm in conducting it.

To know the manner of the muſſels performing this operation, this diligent obſerver put ſome muſſels into a veſſel in his chamber, and covered them with ſea water; he there ſaw that they ſoon began to open their ſhells, and each put forth that little body before deſcribed by its reſemblance to a tongue, and at the root of which theſe threads grow; they extended and ſhortened this part ſeveral times, and thruſt it out every way, often giving it not leſs than two inches in length, and trying before, behind, and on every ſide with it, what were the proper places to fix their threads at: at the end of theſe trials they let it remain fixed for ſome time on the ſpot which they choſe for that purpoſe, and then drawing it back into the ſhell with great quickneſs, it was eaſy to ſee that they were then faſtened by one of theſe threads to the ſpot where it had before touched and remained fixed for a few minutes; and in repeating this workmanſhip the threads are increaſed in number one at every time, and being fixed in different places they ſuſtain the fiſh at reſt againſt any common force.

The ſeveral threads were found to be very different from one another; the new formed ones being ever whiter, more gloſſy, and more tranſparent than the others: and it appeared on a cloſe examination, that it was not, as might have been moſt naturally ſuppoſed, the office of the tongue to convey the old threads one by one to the new places where they were now to be fixed, but that theſe in reality were now become uſeleſs; and that every thread we ſee now formed, is a new one made at this time; and in fine, that nature has given to ſome ſea-fiſhes, as well as to many land-inſects, a power of ſpinning thoſe threads for their neceſſary uſes; and that muſſels and the like fiſh are under water, what caterpillars and ſpiders are at land.—To be well aſſured of this, however, Mr Reaumur cut off the beard or old threads of a muſcle as cloſe as he could, without injuring the part; and the proof of the opinion of their ſpinning new ones at pleaſure was now brought to this eaſy trial, whether theſe muſſels, ſo deprived of their old ones, could fix themſelves as ſoon as others which were poſſeſſed of theirs, and could throw out their threads to as conſiderable diſtances.—

The

Mytilus.

two ovaries and two ſeminal veſicles. Each ovary and veſicle has its proper duct. It is through thoſe four channels that the eggs and the ſeed of the muſſel are conveyed to the anus, where thoſe two principles unite at their iſſue, which anſwers the purpoſe of generation. It is in the ſpring that muſſels lay their eggs; there being none found in them but in winter. M. Lewenhoek, in ſeveral muſſels which he diſſected, diſcovered numbers of eggs or embryo muſſels in the ovarium, appearing as plainly as if he had ſeen them by the naked eye, and all lying with their ſharp ends faſtened to the ſtring of veſſels by which they receive nouriſhment. The minute eggs, or embryos, are by the parent placed in due order, and in a very cloſe arrangement on the outſide of the ſhell, where, by means of a gluey matter, they adhere very faſt, and continually increaſe in ſize and ſtrength, till becoming perfect muſſels, they fall off and ſhift for themſelves, leaving the holes where they were placed behind them. This abundance the muſſel ſhells very plainly ſhow, when examined by the microſcope, and ſometimes the number is 2000 or 3000 in one ſhell: but it is not certain that theſe have been all fixed there by the muſſel within; for theſe fiſh uſually lying in great numbers near one another, the embryos of one are often affixed to the ſhell of another. The fringed edge of the muſſel, which Lewenhoek calls the *beard*, has in every the minuteſt part of it ſuch variety of motions as is inconceivable; for being compoſed of longiſh fibres, each fibre has on both ſides a vaſt many moving particles. Mytilus.

The muſſel is infeſted by ſeveral enemies in its own element; according to Reaumur it is in particular the prey of a ſmall ſhell-fiſh of the trochus kind. This animal attaches itſelf to the ſhell of the muſſel, pierces it with a round hole, and introduces a ſort of tube five or ſix lines long, which it turns in a ſpiral direction, and with which it ſucks the ſubſtance of the muſſel. Muſſels are alſo ſubject to certain diſeaſes, which have been ſuppoſed to be the cauſe of thoſe bad effects which ſometimes happen from the eating of them. Theſe are ſtated by Dr Mœhring, in the 7th vol. of the German Ephemerides, to be the moſs and the ſcab. The roots of the moſs being introduced into the ſhell, the water penetrates through the openings, and gradually diſſolves the muſſel. The ſcab is formed by a ſort of tubercles which are produced by the diſſolution of the ſhell. Certain ſmall crabs, which are ſometimes found in muſſels, likewiſe tend to make them unwholeſome.

The

The experiment proved the truth of the conjecture; for thoſe whoſe beards or old threads were cut off, fixed themſelves as ſoon as thoſe in which they were left, and ſpread their threads to as great a diſtance every way.

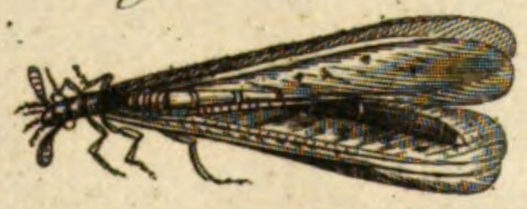
When the mechaniſm of this manufacture was thus far underſtood, it became a natural deſire to inquire into the nature of the part by which it was performed. This has hitherto been mentioned under the name of the tongue, from its ſhape; but it is truly the arm of the fiſh; and whenever it happens to be looſened from its company, or fixed in a wrong place, it ſerves the animal to drag its whole body ſhell and all along, and to perform its ſeveral motions. It fixes itſelf to ſome ſolid body; and then ſtrongly contracting its length, the whole fiſh muſt neceſſarily follow it, and be pulled toward the place where it is fixed. This is an uſe, however, that this part is ſo rarely put to, that it is not properly to be eſteemed a leg or an arm for this; but, according to its more frequent employment, may much better be denominated the organ by which the threads are ſpun. Though this body is flat in the manner of a tongue for the greater part of its length, it is however rounded or cylindric about the baſe or inſertion, and it is much ſmaller there than in any other part: there are ſeveral muſcular ligaments faſtened to it about the root or baſe, which hold it firmly againſt the middle of the back of the ſhell; of theſe ligaments there are four which are particularly obſervable, and which ſerve to move the body in any direction. There runs all along this body a ſlit or crack, which pierces very deeply into its ſubſtance, and divides it as it were into two longitudinal ſections; this is properly a canal, and along this is thrown the liquor which ſerves to form the threads; and it is in this canal or ſlit that theſe threads are moulded into their form. Externally, this appears only a ſmall crack or ſlit, becauſe the two fleſhy ſections of the parts almoſt meet and cover it; but it is rounded and deep within, and is ſurrounded with circular fibres. This canal is carried regularly on from the tip of the tongue, as it is called, to its baſe, where it becomes cylindric; the cylinder in this part being no other than a cloſe tube or pipe, in which this open canal terminates. The cylindric tube contains a round oblong body, of the nature of the threads, except that it is much larger; and from the extremity of this all the threads are produced, this ſerving as a great cable to which all the other little cordages diſperſed towards different parts are fixed. The tube or pipe in which this large thread is lodged, ſeems the reſervoir of the liquor of which the other threads are formed; all its internal ſurface being furniſhed with glands for its ſecretion.

The muſſel, like many other ſea-fiſhes, abounds in this liquor; and if at any time one touch with a finger the baſe of this ſpinning organ, one draws away with it a viſcous liquor in form of ſeveral threads, like thoſe of the caterpillar, ſpider, and the other ſpinning land-animals. The threads fix themſelves with equal eaſe to the moſt ſmooth and gloſſy, as to rougher bodies; if the muſſels are kept in glaſs-jars of ſea-water, they as firmly faſten themſelves to the glaſs as to any other body. Muſſels, be they ever ſo young, have this property of ſpinning; and by this means they faſten themſelves in vaſt numbers to any thing which they find in the ſea. Mr Reaumur has ſeen them, when as ſmall as millet-ſeeds, ſpin plentifully, though their threads, proportioned to their own weight, are much finer and ſmaller than thoſe of larger muſſels.

Myrtus pimenta.

Myxine.

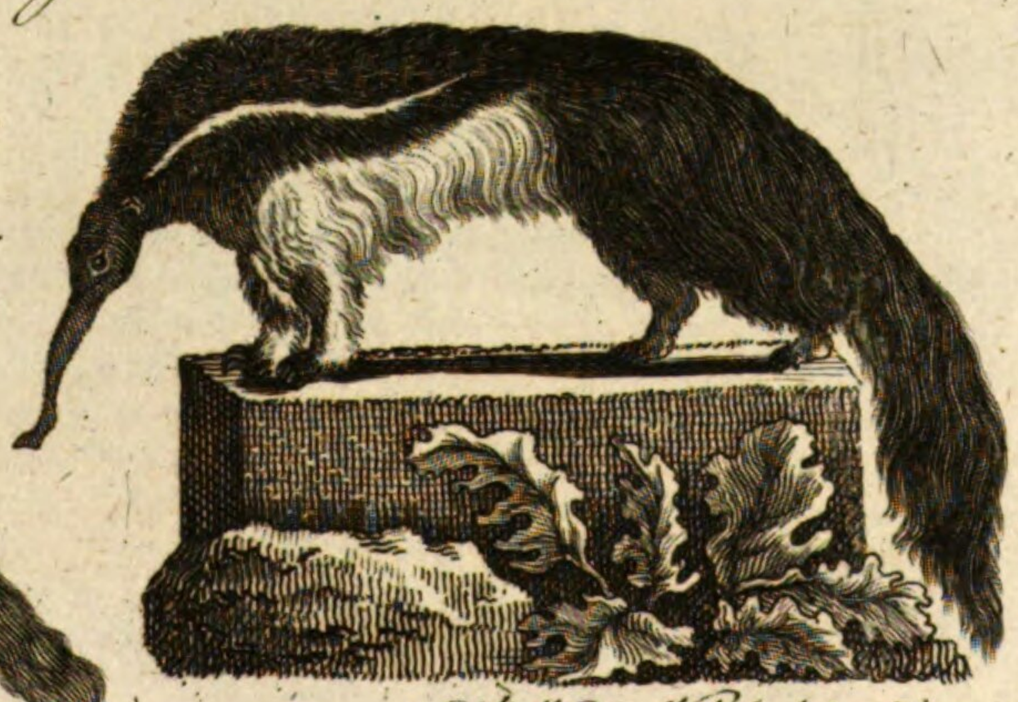
Myrmelion.



M. didactyla.

Myrmecophaga.

M. jubata.



M. tetradactyla.

A. Bell Prin. Wal. Sculptor fecit.

Mytilus.

The eating of muſſels has ſometimes produced eryſipelatous inflammations, cutaneous eruptions, inſupportable itching all over the body, great reſtleſſneſs and agitation; and though theſe complaints are eaſily removed by oil, milk, and emetics, and have ſeldom or never proved mortal, yet they have an alarming aſpect, and make the patient ſuffer grievouſly. Theſe noxious effects have been ſuppoſed to be owing to the muſſels or part of them having been diſeaſed. Some authors, however, have pretended that thoſe effects never take place but between the vernal and autumnal equinox: and M. Beunie, phyſician at Antwerp, in a memoir on this ſubject, ſeems inclined to adopt this opinion; for he recommends abſtinence from muſſels during the months of May, June, July, and Auguſt. The cauſe of theſe noxious effects in the muſſel is, according to this author, altogether accidental. They are occaſioned, he ſays, by a kind of ſtella marina, a little ſea inſect pretty common about the mouth of the Scheldt, which ſometimes lodges itſelf in the muſſel in queſt of food; and whoſe ſpawn is ſo cauſtic and inflammatory, that, even when applied outwardly to the ſkin, it produces itching and ſwellings that are painful in a high degree. The itching occaſioned by touching the ſpawn of the ſtella marina is removed by vinegar; and this known fact induced Dr Beunie to preſcribe the internal uſe of vinegar, after bleeding, evacuations, and emetics. His method conſiſts in recommending a large quantity of refreſhing beverage, and, every hour, three ounces of vinegar diluted in water. This remedy, however, ſeems rather to confirm the opinion of thoſe who impute the diſorder in queſtion to an unperceived commencement of putrefaction in the muſſel: as vinegar is known to be a powerful antiſeptic, and there is no ſort of putrefaction more noxious and offenſive than that of fiſh.—Upon the whole, the edulis, or eatable muſſel, though a rich food, is difficult of digeſtion. In its beſt ſtate it is even noxious to ſome conſtitutions; and when affected by diſeaſe is in ſome degree poiſonous. Muſſels are apt to do moſt harm when eaten raw. They ought always to be boiled with onions, well waſhed with vinegar, and ſeaſoned with pepper; and even thus qualified, they ſhould not be eaten to exceſs or too frequently.

Freſh-water muſſels are not ſo good eating as the ſea-muſſel. The river muſſel, according to M. Poupart, ſwims in the water, and ſometimes appears to flutter on its ſurface. But we believe it more commonly creeps in the mud, where it remains almoſt always at reſt. The pond muſſel is always larger than that which is found in rivers; and it is a more ſolitary animal. In its motion it makes tracks in the ſand and mud, as already obſerved; and it penetrates into it two or three inches, and ſometimes more. Pearls of conſiderable beauty are found in ſeveral river-muſſels; of this kind are the Scots muſſels, thoſe of Valognes in Lorrain, of St Savinier, of Bavaria, and of the marſhes near Augſburg.

Myttoton. || Myxine.

MYTTOTON, a coarſe kind of food, uſed by the labouring people among the Greeks, and ſometimes among the Romans. It was made of garlic, onions, eggs, cheeſe, oil, and vinegar, and reckoned very wholeſome.

MYUS (anc. geog.), one of the twelve towns of Ionia; ſeated on the Meander, at the diſtance of 30 ſtadia from the ſea. In Strabo's time it was incorporated with the Mileſians, on account of the paucity of its inhabitants, from its being formerly overwhelmed with water; for which reaſon the Ionians conſigned its ſuffrage and religious ceremonies to the people of Miletus. Artaxerxes allotted this town to Themiſtocles, in order to furniſh his table with meat: Magneſia was to ſupport him in bread, and Lampſacus in wine. The town now lies in ruins.

MYXINE, the HAG; a genus of inſects belonging to the order of vermes inteſtini. It hath a ſlender body. carinated beneath; mouth at the extremity, cirrated; the two jaws pinnated; an adipoſe or rayleſs fin round the tail and under the belly. The only remarkable ſpecies is the glutinoſa, about eight inches long. It inhabits the ocean; enters the mouths of fiſh when on the hooks of lines that remain a tide under water, and totally devours the whole, except ſkin and bones. The Scarborough fiſhermen often take it in the robbed fiſh, on drawing up their lines. Linnæus attributes to it the property of turning water into glue.

N.

N A liquid conſonant, and the 13th letter of the Greek, Latin, Engliſh, &c. alphabets.

The *n* is a naſal conſonant: its ſound is that of a *d*, paſſed through the noſe; ſo that when the noſe is ſtopped by a cold, or the like, it is uſual to pronounce *d* for *n*. M. l'Abbe de Dangeau obſerves, that in the French, the *n* is frequently a mere naſal vowel, without any thing of the conſonant in it. He calls it the Sclavonic vowel. The Hebrews call their *n nun*, which ſignifies child, as being ſuppoſed the offspring of *m*; partly on account of the reſemblance of ſound, and partly on that of the figure. Thus from the *m*, by omitting the laſt column, is formed *n*; and thus from the capital N, by omitting the firſt column, is formed the Greek minuſcle ν. Hence for *biennies*, &c. the Latins frequently uſe *bimus*, &c. and the ſame people convert the Greek ν, at the end of a word, into an *m*, as φαρμακον, *pharmacum*, &c. See M.

N before *p*, *b*, and *m*, the Latins change into *m*, and frequently into *l* and *r*; as in *in-ludo*, *illudo*; *in-rigo*,

Naarda || Nabis.

rigo, *irrigo*, &c.: in which they agree with the Hebrews, who, in lieu of *nun*, frequently double the following conſonants: and the Greeks do the ſame; as when for *Manlius*, they write Μαλλιος, &c. The Greeks alſo, before κ, γ, χ, ν, changed the ν into γ: in which they were followed by the ancient Romans; who, for *Angulus*, wrote *Aggulus*; for *anceps*, *agceps*, &c.

The Latins retrench the *n* from Greek nouns ending in ων; as Λεων, *Leo*; Δρακων, *Draco*: on the contrary, the Greeks add it to the Latin ones ending in *o*; as Κατων, Νερων, *Cato*, *Nero*.

N, among the ancients, was a numeral letter, ſignifying 900; according to the verſe in Baronius,

N, *quoque nongentos numero deſignat habendos*.

And when a line was ſtruck over it, $\overline{N}$, nine thouſand. Among the ancient lawyers *N. L.* ſtood for *non liquet*, i. e. the cauſe is not clear enough to paſs ſentence upon. N, or N°, in commerce, &c. is uſed as an abbreviation of *numero*, number.

NAARDA, Nearda, *Neerda*, or *Nehardea*, (anc. geog.), a town ſituated on the confines of Meſopotamia and Babylonia; populous, and with a rich and extenſive territory, not eaſily to be attacked by an enemy, being ſurrounded on all ſides by the Euphrates and ſtrong walls (Joſephus). In the lower age the Jews had a celebrated ſchool there.

NAAS, a borough and poſt town of Ireland, in the county of Kildare and province of Leinſter. It is the ſhire town of that county, and alternately with Athy the aſſizes town. It is diſtant above 15 miles ſouth weſt of Dublin, in N. Lat. 53. 10. W. Long. 6. 50. It ſends two members to parliament; and gives title of viſcount to the family of Burke. It has five fairs in the year.—This place was anciently the reſidence of the kings of Leinſter: the name ſignifies "the place of elders," for here the ſtates of that province aſſembled during the 6th, 7th, and 8th centuries, after the Naaſteighan of Carmen had been anathematiſed by the Chriſtian clergy. On the arrival of the Engliſh it was fortified; many caſtles were erected, the ruins of which are partly viſible; and parliaments were held there. At the foot of the mount or rath are the ruins of a houſe founded in 1484, for eremites of the order of St Auguſtin. In the 12th century the baron of Naas founded a priory dedicated to St John the Baptiſt, for Auguſtinian regular canons. In the centre of this town the family of Euſtace erected a monaſtery for Dominican friars, dedicated to St Euſtachius; and it appears that their poſſeſſions in Naas were granted them in the year 1355. This place was a ſtrong hold during the civil wars.

NABATENE, or Regio Nabataeorum, according to Jerome, compriſed all the country lying between the Euphrates and the Red Sea, and thus contained Arabia Deſerta, with a part of the Petræa: ſo called from Nabaioth, the firſt born of Iſmael. According to Diodorus, it was ſituated between Syria and Egypt. The people Nabatæi (1 Maccabees, Diodorus Siculus); inhabiting a deſart and barren country; they lived by plundering their neighbours according to Diodorus. Nabathæus the epithet.

NABIS, tyrant of Sparta, reigned about 204 B.C.; and is reported to have exceeded all other tyrants ſo far, that, upon compariſon, he left the epithets of *gracious* and *merciful* to Dionyſius and Phalaris. He is ſaid to have contrived an inſtrument of torture in the form of a ſtatue of a beautiful woman, whoſe rich dreſs concealed a number of iron ſpikes in her boſom and arms. When any one therefore oppoſed his demands, he would ſay, "If I have not talents enough to prevail with you, perhaps my woman Apega may perſuade you." The ſtatue then appeared; which Nabis taking by the hand, led up to the perſon, who, being embraced by it, was thus tortured into compliance. To render his tyranny leſs unpopular, Nabis made an alliance with Flaminius the Roman general, and purſued with the moſt inveterate enmity the war which he had undertaken againſt the Achæans. He beſieged Gythium, and defeated Philopœmen in a naval battle. His triumph was ſhort, the general of the Achæans ſoon repaired his loſſes, and Nabis was defeated in an engagement, and killed as he attempted to ſave his life by flight, about 194 years before the Chriſtian era.

Nablous || Nabuchadnezzar.

NABLOUS, a province of Syria anciently celebrated under the name of the *kingdom of Samaria*. Its capital, likewiſe called *Nablous*, is ſituated near to Sichem on the ruins of the Niepolis of the Greeks, and is the reſidence of a ſhaik, who is ſubordinate to the pache of Damaſcus, from whom he farms the tribute of the province.

NABLUM, in Hebrew, *Nebel*, was an inſtrument of muſic among the Jews. It had ſtrings like the harp, and was played upon by both hands. Its form was that of a Greek Δ. In the Septuagint and Vulgate, it is called *nablum*, *pſalterion*, *lyra*; and ſometimes *cithara*.

NABO, or Nebo, in mythology, a deity of the Babylonians, who poſſeſſed the next rank to Bel. It is mentioned by Iſaiah, chap. xlviii. Voſſius apprehends that Nabo was the moon, and Bel the ſun: but Grotius ſuppoſes that Nabo was ſome celebrated prophet of the country; which opinion is confirmed by the etymology of the name, ſignifying, according to Jerom, "one that preſides over propheſy."

NABOB, properly Navab, the plural of *Naib*, a deputy. As uſed in Bengal, it is the ſame as Nazim. It is a title alſo given to the wives and daughters of princes, as well as to the princes themſelves.

NABONASSAR, firſt king of the Chaldæans or Babylonians; memorable for the Jewiſh æra which bears his name, which is generally fixed in 3257, beginning on Wedneſday February 26th in the 3967th of the Julian period, 747 years before Chriſt. The Babylonians revolting from the Medes, who had overthrown the Aſſyrian monarchy, did, under Nabonaſſar, found a dominion, which was much increaſed under Nebuchadnezzar. It is probable, that this Nabonaſſar is that Baladan in the ſecond of Kings xx. 12. father of Merodach, who ſent ambaſſadors to Hezekiah. See 2 Chron. xxxii.

NABOPOLASSAR, king of Babylon: he joined with Aſtyages the Mede, to deſtroy the empire of Aſſyria; which having accompliſhed, they founded the two empires of the Medes under Aſtyages, and the Chaldæans under Nabopolaſſar, 627 B. C.

NABUCHADNEZZAR, or Nabuchodonosor II. king of Aſſyria, ſon of Nabopolaſſar, and ſtyled the *Great*, was aſſociated by his father in the empire, 607 B. C. and the following year he took Jehoiakim

king

Nadir || Nævius.

king of Judah priſoner, and propoſed to carry him and his ſubjects in captivity into Babylon; but upon his ſubmiſſion, and promiſing to hold his kingdom under Nabuchodonoſor, he was permitted to remain at Jeruſalem. In 603 B. C. Jehoiakim attempted to ſhake off the Aſſyrian yoke, but without ſucceſs; and this revolt brought on the general captivity. Nabuchadnezzar having ſubdued the Ethiopians, Arabians, Idumæans, Philiſtines, Syrians, Perſians, Medes, Aſſyrians, and almoſt all Aſia; being puffed up with pride, cauſed a golden ſtatue to be ſet up, and commanded all to worſhip it; which Daniel's companions refuſing to do, they were caſt into the fiery furnace. But as he was admiring his own magnificence, by divine ſentence he was driven from men, and in the ſcripture ſtyle is ſaid to have eaten graſs as oxen: i. e. he was ſeized with the diſeaſe called by the Greeks *lycanthropy*, which is a kind of madneſs that cauſes perſons to run into the fields and ſtreets in the night, and ſometimes to ſuppoſe themſelves to have the heads of oxen, or to be made of glaſs. At the end of ſeven years his reaſon returned to him, and he was reſtored to his throne and glory. He died 562 B. C. in the 43d year of his reign; in the 5th of which happened that eclipſe of the ſun mentioned by Ptolemy, which is the ſureſt foundation of the chronology of his reign.

NADIR, in aſtronomy that point of the heavens which is diametrically oppoſite to the zenith or point directly over our heads.

NÆNIA, the goddeſs of funerals at Rome. Her temple was without the gates of the city. The ſongs which were ſung at funerals were alſo called *nænia*. They were generally filled with the praiſes of the deceaſed; but ſometimes they were ſo unmeaning and improper, that the word became proverbial to ſignify nonſenſe.

NAERDEN, a ſtrong town of the United Provinces in Holland, ſeated at the head of the canals of the province. The foundations of it were laid by William of Bavaria, in 1350. It was taken by the Spaniards in 1572, and by the French in 1672; but it was retaken by the prince of Orange the next year. It ſtands at the ſouth end of the Zuyder-Zee, in E. Long. 5. 3. N. Lat. 51. 22.

NÆVIUS (Cneius), a famous poet of Campania, was bred a ſoldier; but quitted the profeſſion of arms, in order to apply himſelf to poetry, which he proſecuted with great diligence. He compoſed a hiſtory in verſe, and a great number of comedies: But it is ſaid, that his firſt performance of this laſt kind ſo diſpleaſed Metellus on account of the ſatyrical ſtrokes it contained, that he procured his being baniſhed from the city; on which he retired to Utica in Africa, where he at length died, 202 B. C. We have only ſome fragments left of his works.

There was another NÆVIUS a famous augur in the reign of Tarquin, who, to convince the king and the Romans of his preternatural power, cut a flint with a raſor, and turned the ridicule of the populace to admiration. Tarquin rewarded his merit by erecting him a ſtatue in the comitium, which was ſtill in being in the age of Auguſtus. The raſor and flint were buried near it under an altar, and it was uſual among the Romans to make witneſſes in civil cauſes ſwear near it. This miraculous event of cutting a flint with a raſor, though believed by ſome writers, is treated as fabulous and improbable by Cicero, who himſelf had been an augur.

Nævus || Nagracut.

NÆVUS, a mole on the ſkin, generally called a *mother's mark*; alſo the tumour known by the name of a *wen*.

All preternatural tumours on the ſkin, in the form of a wart or tubercle, are called *excreſcences*; by the Greeks they are called *acrothymia*; and when they are born with a perſon, they are called *nævi materni*, or *marks from the mother*. A large tumour depending from the ſkin is denominated *ſarcoma*. Theſe appear on any part of the body: ſome of them differ not in their colour from the reſt of the ſkin; whilſt others are red, black, &c. Their ſhapes are various; ſome reſembling ſtrawberries, others grapes, &c. Heiſter adviſes their removal by means of a ligature, a cautery, or a knife, as circumſtances beſt ſuit.

As to the tumour called a *wen*, its different ſpecies are diſtinguiſhed by their contents. They are encyſted tumours; the matter contained in the firſt three following is inſpiſſated lymph, and that in the fourth is only fat. Monſ. Littre was the firſt who particularly deſcribed the fourth kind; and to the following purpoſe he ſpeaks of them all. A wen is ſaid to be of three ſorts, according to the kind of matter it contains: thoſe whoſe contents reſemble boiled rice, or curds, or a bread-poultice, is called *atheroma*; if it reſembles honey, it is named *meliceris*; and if it is like ſuet, it is denominated *ſteatoma*: but there is a fourth ſort, which may be called *lipome*, becauſe of its fat contents reſembling greaſe. He ſays that he has ſeen one on the ſhoulders of a man, which was a thin bag, of a tender texture, full of a ſoft fat, and that it had all the qualities of common greaſe. And though the fat in the lipome reſembles that in the ſteatoma, yet they cannot be the ſame: for the matter of the ſteatoma is not inflammable, nor does it melt; or if it does, it is with great difficulty and imperfectly; whereas it is the contrary with the lipome. When the man who had the above-named lipome was fatigued, or had drank freely of ſtrong liquors, his lipome was inflamed for ſome days after, and its contents rarefying increaſed the ſize of the tumour.

The lipome ſeems to be no other than an enlargement of one or more of the cells of the adipoſe membrane, which is filled only with its natural contents. Its ſoftneſs and largeneſs diſtinguiſh it in general from the other ſpecies, though ſometimes the fatty contents will be ſo hard as to deceive. As this kind of wen does not run between the muſcles, nor is poſſeſſed of any conſiderable blood-veſſels, it may always be cut off with eaſe and ſafety.

As to the other kind of wens, their extirpation may or may not be attempted, according as their ſituation is with reſpect to adjacent veſſels, the wounding of which would endanger the patient's life.

NAGERA, or NAGARA, a town of Spain, in Old Caſtile, and the territory of Rioja, with the title of a duchy and fortreſs; famous for a battle fought in its neighbourhood in 1369. It is ſituated in a fertile country, on a brook called *Naſerilla*. W. Long. 2. 20. N. Lat. 42. 25.

NAGRACUT, a town of India, the capital of a kingdom of the ſame name in the dominions of the

Nahum ‖ Nail.

Great Mogul, with a rich temple to which the Indians go in pilgrimage. It is ſeated on the river Ravi. E. Long. 78. 10. N. Lat. 33. 12.

NAHUM, or the *Prophecy of* NAHUM, a canonical book of the Old Teſtament.

NAHUM, the ſeventh of the 12 leſſer prophets, was a native of Elkoſhai, a little village of Galilee. The ſubject of his prophecy is the deſtruction of Nineveh, which he deſcribes in the moſt lively and pathetic manner; his ſtyle is bold and figurative, and cannot be exceeded by the moſt perfect maſters of oratory. This prophecy was verified at the ſiege of that city by Aſtyages, in the year of the world 3378, 622 years before Chriſt.

NAIADES (fab. hiſt.), certain inferior deities who preſided over rivers, ſprings, wells, and fountains. The Naiades generally inhabited the country, and reſorted to the woods or meadows near the ſtream over which they preſided. They are repreſented as young and beautiful virgins, often leaning upon an urn, from which flows a ſtream of water. Ægle was the faireſt of the Naiades, according to Virgil. Their name ſeems to be derived from ναειν, *to flow*. They were held in great veneration among the ancients; and often ſacrifices of goats and lambs were offered to them, with libations of wine, honey, and oil. Sometimes they received only offerings of milk, fruit, and flowers.

NAIANT, in heraldry, a term uſed in blazoning fiſhes, when borne in an horizontal poſture, as if ſwimming.

NAIAS, in botany: A genus of the monandria order, belonging to the dicœcia claſs of plants; and in the natural method ranking with thoſe of which the order is doubtful. The male calyx is cylindrical and bifid; the corolla quadrifid; there is no filament; nor is there any female calyx or corolla; there is one piſtil; and the capſule is ovate and unilocular.

NAID, the interior of the great deſart of Arabia, inhabited by a few ſcattered tribes of feeble and wretched Arabs. See ARABIA.

NAIL, UNGUIS, in anatomy. See there, n° 81.

NAILS, in building, &c. ſmall ſpikes of iron, braſs, &c. which being drove into wood, ſerve to bind ſeveral pieces together, or to faſten ſomething upon them.

Nails were made uſe of by the ancient Hebrews for cancelling bonds: and the ceremony was performed by ſtriking them through the writing. This ſeems to be alluded to in ſcripture, where God is ſaid by our crucified Saviour to have "blotted out the handwriting of ordinances that was againſt us, and to have taken it out of the way, nailing it to his croſs." Col. ii. 14. For the cauſe and ceremony of driving the annual nail, or *clavus annalis*, among the Romans, ſee *ANNALIS Clavus*.

NAIL, is alſo a meaſure of length, containing the 16th part of a yard.

NAILING of Cannon. When circumſtances make it neceſſary to abandon cannon, or when the enemy's artillery are ſeized, and it is not however poſſible to take them away, it is proper to nail them up, in order to render them uſeleſs; which is done by driving a large nail or iron ſpike into the vent of a piece of artillery, to render it unſerviceable. There are various contrivances to force the nail out, as alſo ſundry machines invented for that purpoſe, but they have never been found of general uſe; ſo that the beſt method is to drill a new vent. Nain ‖ Nairn.

One Gaſper Vimercalus was the firſt who invented the nailing of cannon. He was a native of Bremen, and made uſe of his invention firſt in nailing up the artillery of Sigiſmund Malateſta.

NAIN (Lewis Sebaſtian de), one of the moſt learned and judicious critics and hiſtorians France has produced, was the ſon of a maſter of the requeſts, and born at Paris in 1637. At ten years old he went to ſchool at Port Royal, and became one of the beſt writers of that inſtitution. Sacy, his intimate friend and counſellor, prevailed with him in 1676 to receive the prieſthood; which, it ſeems, his great humility would not before ſuffer him to aſpire to. This virtue he ſeems to have poſſeſſed in the extreme; ſo that Boſſuet, ſeeing one of his letters to father Dami, with whom he had ſome little diſpute, beſought him merrily "not to be always upon his knees before his adverſary, but raiſe himſelf now and then up." He was ſolicited to puſh himſelf in the church, and Buzanval, biſhop of Beauvois, wiſhed to have him for his ſucceſſor: but Nain, regardleſs of dignities, wiſhed for nothing but retirement. In this he did indeed moſt effectually bury himſelf; and, joining the mortifications of a religious life to an indefatigable purſuit of letters, he wore himſelf entirely out, ſo as to die in 1698, aged 61, though he was formed for a longer life. His principal works are, 1. Memoirs on the eccleſiaſtical hiſtory of the ſix firſt ages of the church, 16 vols 4to. 2. The hiſtory of the emperors, 6 vols 4to. Theſe works are deduced from original ſources, and compoſed with the utmoſt fidelity and exactneſs.

NAIN, or NAIM, ſituated at the bottom of mount Hermon on the north ſide, was anciently a city of the tribe of Iſſachar, in the province of Galilee. It was near the gates of this city that our Saviour reſtored to life the only ſon of a widow, and where he inſpired Mary Magdalen to come and mourn for her ſins at his feet. Theſe circumſtances alone make this place worthy of notice; for at preſent Nain is only a hamlet inhabited by Chriſtians, Mahometans, and Hebrews, where there is not a ſingle monument to attract the curioſity of the traveller.

NAIRES, NAHERS, or NAYERS, in modern hiſtory, a name which is given by the Malabarians to the military of their country, who form a very numerous claſs or tribe, out of which the ſovereigns of Malabar chooſe their body-guard.

NAIRN, a county of Scotland, comprehending the weſt part of Murray. It is bounded on the north by Murray frith, on the weſt and ſouth by Inverneſs, and on the eaſt by Elgin. The length of it amounts to 20 miles, and the breadth to 14. The air is temperate and ſalubrious, and the winters are remarkably mild. The face of the country is rough and mountainous; yet there are ſome fruitful ſtraths, or valleys, which produce good crops of oats and barley; but in general the country is much better adapted for paſturage. Here are alſo large woods of fir, and other trees, that afford ſhelter to the game, of which there is great plenty. A ſtrath is a long, narrow valley, with a river running through the bottom. Of theſe, the moſt remarkable

Naiſſant || Name.

remarkable in this county, are Strathnairn, on the river of that name, in the ſouth-weſt part of the ſhire; and on the ſouth-eaſt ſide, Stratherin, on both ſides of Findhorne river. Nairn is well watered with ſtreams, rivulets, and lakes, abounding with fiſh. In the ſouthern part there is a ſmall lake, called *Moy*, ſurrounding an iſland, on which there is a caſtle belonging to the laird of M'Intoſh: but the greater part of the ſhire is peopled by the Fraſers, a warlike Highland clan, whoſe chief, the Lord Lovat, loſt his life on a ſcaffold for having been concerned in the late rebellion. Here are a great number of villages; but no towns of note except Nairn, ſuppoſed to be the *Tuæſis* of Ptolemy, ſituated at the mouth of the river which bears the ſame name; a royal borough, which gave a title of *lord* to an ancient family, forfeited in the rebellion of 1715. The harbour, which opened in the Murray frith, is now choaked up with ſand; and the commerce of the town is too inconſiderable to deſerve notice. The people in general ſubſiſt by feeding ſheep and black cattle. About four miles from Nairn ſtands the caſtle of Calder, on the river of that name, belonging to a branch of the family of Campbell. In this neighbourhood we find a quarry of free-ſtone, and many ſigns of copper. About ſix miles to the north-weſt of Nairn, a new fort hath been lately built by order of the government, at a place called *Ardeſeer*, a ſmall iſthmus upon the Murray frith, which it is intended to command.

NAISSANT, in heraldry, is applied to any animal iſſuing out of the midſt of ſome ordinary, and ſhowing only his head, ſhoulders, fore-feet, and legs, with the tip of his tail; the reſt of his body being hid in the ſhield, or ſome charge upon it: in which it differs from *iſſuant*, which denotes a living creature ariſing out of the bottom of any ordinary or charge.

NAISSUS (anc. geog.), a town of Dardania, a diſtrict of Mœſia Superior, ſaid to be the birth-place of Conſtantine the Great, which ſeems probable from his often reſiding at that place. *Naiſſitani*, the people (Coin). Now called *Niſſa*, a city of Servia. E. Long. 23° N. Lat. 43°.

NAKED SEEDS, in botany, thoſe that are not incloſed in any pod or caſe.

NAKIB, in the oriental dignities, the name of an officer who is a deputy to the cadiliſkier, or, as he may be called, the lord high chancellor of Egypt, appointed by the grand ſignior. His office is to carry the ſtandard of Mahomet.

NAKOUS, an Egyptian muſical inſtrument, made like two plates of braſs, and of all ſizes, from two inches to a foot in diameter; they hold them by ſtrings faſtened to their middles, and ſtrike them together ſo as to beat time. They are uſed in the Cophtic churches and in the Mahometan proceſſions.

NAMA, in botany: A genus of the digynia order, belonging to the pentandria claſs of plants; and, in the natural method, ranking under the 13th order, *Succulentæ*. The calyx is pentaphyllous, the corolla quinquepartite, the capſule unilocular and bivalved.

NAME, denotes a word whereby men have agreed to expreſs ſome idea; or which ſerves to denote or ſignify a thing or ſubject ſpoken of. See WORD.

This the grammarians uſually call a *noun*, *nomen*, though their noun is not of quite ſo much extent as our name. See NOUN. Name.

Seneca, Lib. II. *de Beneficiis*, obſerves, that there are a great number of things which have no name; and which, therefore, we are forced to call by other borrowed names. *Ingens eſt* (ſays he) *rerum copia ſine nomine, quas cum propriis appellationibus ſignare non poſſumus, alienis accommodatis utimur:* which may ſhow why, in the courſe of this dictionary, we frequently give divers ſenſes to the ſame word.

Names are diſtinguiſhed into *proper* and *appellative*.

Proper NAMES, are thoſe which repreſent ſome individual thing or perſon, ſo as to diſtinguiſh it from all other things of the ſame ſpecies; as, *Socrates*, which repreſents a certain philoſopher.

Appellative or *General* NAMES, are thoſe which ſignify common ideas; or which are common to ſeveral individuals of the ſame ſpecies; as, *horſe*, *animal*, *man*, *oak*, &c.

Proper names are either called *Chriſtian*, as being given at baptiſm; or ſurnames: The firſt impoſed for diſtinction of perſons, anſwering to the Roman *prænomen;* the ſecond, for the diſtinction of families, anſwering to the *nomen* of the Romans, and the *patronymicum* of the Greeks.

Originally every perſon had but one name; as among the Jews, *Adam*, &c. among the Egyptians, *Buſiris;* among the Chaldees, *Ninus;* the Medes, *Aſtyages;* the Greeks, *Diomedes;* the Romans, *Romulus;* the Gauls, *Divitiacus;* the Germans, *Arioviſtus;* the Britons, *Caſſibelan;* the Engliſh, *Hengiſt*, &c. And thus of other nations, except the ſavages of Mount Atlas, whom Pliny and Marcellinus repreſent as *anonyme*, "nameleſs."

The Jews gave the name at the circumciſion, *viz.* eight days after the birth: the Romans, to females the ſame day, to males the ninth; at which time they held a feaſt, called *nominalia*.

Since Chriſtianity has obtained, moſt nations have followed the Jews, baptizing and giving the name on the eighth day after the birth; except our Engliſh anceſtors, who, till of late, baptized and gave the name on the birth-day.

The firſt impoſition of names was founded on different views, among different people; the moſt common was to mark the good wiſhes of the parents, or to entitle the children to the good fortune a happy name ſeemed to promiſe. Hence, *Victor*, *Caſtor*, *Fauſtus*, *Statorius*, *Probus*, &c.

Accordingly, we find ſuch names, by Cicero called *bona nomina*, and by Tacitus *fauſta nomina*, were firſt enrolled and ranged in the Roman muſters; firſt called to ſerve at the ſacrifices, in the foundation of colonies, &c.—And, on the contrary, Livy calls Atrius Umber, *abominandi omnis nomen:* and Plautus, on occaſion of a perſon named *Lyco*, i. e. "greedy wolf," ſays;

Voſmet nunc facite conjecturam cæterum
Quid id ſit hominis, cui Lyco *nomen fiet.*

Hence, Plato recommends it to men to be careful in giving happy names; and the Pythagoreans taught expreſsly, that the minds, actions, and ſucceſſes of men, were according to their names, genius, and fate. Thus

Name. Panormitan, *ex bono nomine oritur bona præſumptio*; and the common proverb, *Bonum nomen bonum omen*: and hence the foundation of the onomomantia. See ONOMOMANTIA.

It is an obſervation deſerving attention, ſays the Abbé Barthelemi, that the greater part of names found in Homer are marks of diſtinction. They were given in honour of the qualities moſt eſteemed in the heroic ages. From the word *polemos*, which ſignifies war, have been formed *Tlepolemus* and *Archeptolemus*, the names of two heroes mentioned in the Iliad. The former name ſignifies *able to ſupport*, and the latter, *able to direct, the labours of war*. By adding to the word *mache*, or *battle*, certain prepoſitions and different parts of ſpeech, which modify the ſenſe in a manner always honourable, are compoſed the names *Amphimachus*, *Antimachus*, *Promachus*, *Telemachus*. Proceeding in the ſame way with the word *honorea*, "ſtrength or intrepidity," they formed the names *Agapenor*, "he who eſteems valour;" *Agenor*, "he who directs it." From *thoes*, "ſwift," are derived, *Alcathoes*, *Panthoes*, *Perithoes*, &c. From *nous*, "mind or intelligence," come *Aſtynoes*, *Arſinoes*, *Autenoes*, &c. From *medes*, "counſel," *Agamedes*, *Eumedes*, *Lycomedes*, *Thraſymedes*; and from *clios*, "glory," *Amphicles*, *Agacles*, *Iphicles*, *Patroclus*, *Cleobulus*, with many others.

Hence Camden takes it for granted, that the names, in all nations and languages, are ſignificative, and not ſimple ſounds for mere diſtinction ſake. This holds not only among the Jews, Greeks, Latins, &c. but even the Turks; among whom, Abdalla ſignifies *God's ſervant*; Soliman, *peaceable*: Mahomet, *glorified*, &c. And the ſavages of Hiſpaniola, and throughout America, who, in their languages, name their children, *Gliſtering Light*, *Sun Bright*, *Fine Gold*, *&c.*; and they of Congo, by the names of precious ſtones, flowers, &c.

To ſuppoſe names given without any meaning, however by the alteration of languages their ſignification may be loſt, that learned author thinks is to reproach our anceſtors; and that contrary to the ſenſe of all ancient writers. Porphyry notes, that the barbarous *names*, as he calls them, were very emphatical, and very conciſe: and accordingly it was eſteemed a duty to be ονομαστοι, or *ſui nominis homines*: as Severus, Probus, and Aurelius, are called *ſui nominis imperatores*.

It was the uſual way of giving names, to wiſh the children might diſcharge their names. Thus when Gunthram king of France named Clotharius at the font, he ſaid, *Creſcat puer, & hujus ſit hominis executor*.

The ancient Britons, Camden ſays, generally took their names from colours, becauſe they painted themſelves; which names are now loſt, or remain hid among the Welſh. When they were ſubdued by the Romans, they took Roman names, ſome of which ſtill remain, corrupted; though the greateſt part became extinct upon the admiſſion of the Engliſh Saxons, who introduced the German names, as *Cridda*, *Penda*, *Oſwald*, *Edward*, &c.—The Danes, too, brought with them their names; as *Suayne*, *Harold*, *Knute*, &c. The Normans, at the Conqueſt, brought in other German names, as originally uſing the German tongue; ſuch as *Robert*, *William*, *Richard*, *Henry*, *Hugh*, &c. after the ſame manner as the Greek names: *Aſpaſius*, *Boethius*, *Symmachus*, &c. were introduced into Italy upon the diviſion of the empire. After the Conqueſt, our nation, which had ever been averſe to foreign names, as deeming them unlucky, began to take Hebrew names; as *Matthew*, *David*, *Sampſon*, &c. The various names anciently or at preſent obtaining among us, from what language or people ſoever borrowed, are explained by Camden in his Remains. As to the period when names began to be multiplied, and ſurnames introduced, &c. ſee SURNAME. Name.

Of late years it has obtained among us to give ſurnames for Chriſtian names; which ſome diſlike, on account of the confuſion it may introduce. Camden relates it as an opinion, that the practice firſt began in the reign of Edward VI. by ſuch as would be godfathers, when they were more than half fathers. Upon which ſome were perſuaded to change their names at confirmation; which, it ſeems, is uſual in other countries.—Thus, two ſons of Henry II. of France, chriſtened *Alexander* and *Hercules*, changed them at confirmation into *Henry* and *Francis*. In monaſteries, the religious aſſume new names at their admittance, to ſhow they are about to lead a new life, and have renounced the world, their family, and even their name: *v. g.* ſiſter Mary *of the Incarnation*, brother Henry *of the Holy Sacrament*, &c. The popes alſo changed their names at their exaltation to the pontificate; a cuſtom firſt introduced by Pope Sergius, whoſe name till then, as Platina informs us, was *Swineſnout*. But Onuphrius refers it to John XII. or XIII. and at the ſame time adds a different reaſon for it from that of Platina, viz. that it was done in imitation of St Peter and St Paul, who were firſt called *Simon* and *Saul*.

Among the ancients, thoſe deified by the Heathen conſecrations had new names given them; as Romulus was called *Quirinus*; Melicertes, *Portunus* or *Portumnus*, &c.

New names were alſo given in adoptions, and ſometimes by teſtament: thus L. Æmilius, adopted by Scipio, took the name of *Scipio Africanus*; and thus Auguſtus, who at firſt was called *C. Octavius Thurinus*, being adopted by the teſtament of Julius Cæſar into his name and family, took the name of *Caius Julius Cæſar Octavianus*.

Names were alſo changed at enfranchiſements into new cities. Thus Lucumo, at his firſt being made free of Rome, took the name *Lucius Tarquinius Priſcus*, &c.; and ſlaves, when made free, uſually aſſumed their maſters names. Thoſe called to the equeſtrian order, if they had baſe names, were always new named, *nomine ingenuorum veterumque Romanorum*. And among the primitive Chriſtians, it was the practice to change the names of the catechumens: Thus the renegado Lucianus, till his baptiſm, was called *Lucius*.

Toward the middle of the 15th century, it was the fancy of the wits and learned men of the age, particularly in Italy, to change their baptiſmal names for claſſical ones. As Sannazarius, for inſtance, who altered his own plain name *Jacopo* to *Actius Syncerus*. Numbers did the ſame, and among the reſt Platina the hiſtorian at Rome, who, not without a ſolemn ceremonial,

Nampt-wich || Nan-tchang-fou.

remonial, took the name of *Callimachus* inſtead of *Philip*. Pope Paul II. who reigned about that time, unluckily chanced to be ſuſpicious, illiterate, and heavy of comprehenſion. He had no idea that perſons could wiſh to alter their names unleſs they had ſome bad deſign, and actually ſcrupled not to employ impriſonment and other violent methods to diſcover the fancied myſtery. Platina was moſt cruelly tortured on this frivolous account: he had nothing to confeſs; ſo the pope, after endeavouring in vain to convict him of hereſy, ſedition, &c. releaſed him after a long impriſonment.

NAMPTWICH, or NANTWICH, a town of Cheſhire in England, ſituated on the Weever river, 14 miles S. E. from Cheſter and 162 miles from London. It lies in the Vale-Royal, and is one of the largeſt and beſt built towns in the county, the ſtreets being very regular, and adorned with many gentlemens houſes. The inhabitants drive a trade, not only by its large market on Saturday for corn and cattle, and its great thoroughfare to Ireland, but by its cheeſe and its fine white ſalt, which are made here to the greateſt perfection; and by ſhoes made here and ſent to London to the warehouſes. It is governed by a conſtable, &c. who are guardians of the ſalt-ſprings. It is divided by the Weever into two equal parts, which is not navigable any farther than Winsford-bridge. The Cheſter canal, lately completed, terminates in a handſome broad baſon near this place. In this town were ſeveral religious foundations, now no more. The church is a handſome pile of building in the form of a croſs, with an octangular tower in the middle. There are here three fairs.

NAMUR, a province of the Netherlands, lying between the rivers Sambre and Maeſe; bounded on the north by Brabant, on the eaſt and ſouth by the biſhopric of Leige, and on the weſt by Hainault. It is pretty fertile; has ſeveral foreſts, marble quarries, and mines of iron, lead, and pit-coal; and is about 30 miles long and 20 broad. Namur is the capital town.

NAMUR, a large, rich, and very ſtrong town of the Netherlands, capital of the county of Namur, with a ſtrong caſtle, ſeveral forts, and a biſhop's ſee. The moſt conſiderable forts are, Fort-William, Fort-Maeſe, Fort Coquelet, and Fort-Eſpinor. The caſtle is built in the middle of the town, on a craggy rock. It was beſieged by king William in 1695, who took it in the ſight of an army of 100,000 French, though there were 60,000 men in garriſon. Namur is now a barrier-town, and has a Dutch garriſon. It was ceded to the houſe of Auſtria in 1713, but taken by the French in 1746; and reſtored by the treaty of Aix-la-Chapelle. It is ſituated between two mountains, at the confluence of the rivers Maeſe and Sambre, in E. Long. 4. 57. N. Lat. 50. 25.

NAN-TCHANG-FOU, the capital of Kiang-ſi, a province of China. This city has no trade but that of porcelain, which is made in the neighbourhood of Jao-tcheou. It is the reſidence of a viceroy, and comprehends in its diſtrict eight cities; ſeven of which are of the third claſs, and only one of the ſecond. So much of the country is cultivated, that the paſtures left are ſcarcely ſufficient for the flocks.

NANCI, a town of France, and capital of Lorrain, is ſituated on the river Meuſe, in the centre of the province. It is divided into the Old and New Towns. The firſt, though irregularly built, is very populous, and contains the ducal palace: the ſtreets of the New Town are as ſtraight as a line, adorned with handſome buildings, and a very fine ſquare. The primatial church is a magnificent ſtructure, and in that of the Cordeliers are the tombs of the ancient dukes. The two towns are ſeparated by a canal; and the new town was very well fortified, but the king of France has demoliſhed the fortifications. It has been taken and retaken ſeveral times; particularly by the French, to whom it was ceded in 1736, to enjoy it after the death of Staniſlaus.

Nani, Nan-king.

NANI (John-Baptiſt), was born in 1616. His father was procurator of St Mark, and ambaſſador from Venice to Rome. He was educated with attention, and made conſiderable improvement. Urban VIII. a juſt valuer of merit, ſoon perceived that of young Nani. He was admitted into the college of ſenators in 1641, and was ſhortly after nominated ambaſſador in France, where he ſignalized himſelf by his compliant manners. He procured conſiderable ſuccours for the war of Candia againſt the Turks; and became, after his return to Venice, ſuperintendant of the war-office and of finances. He was afterwards ambaſſador to the empire; where he rendered thoſe ſervices to his country which, as a zealous and intelligent citizen, he was well qualified to diſcharge. He was again ſent into France in 1660 to ſolicit freſh ſuccours for Candia; and on his return was appointed procurator of St Mark. He died November 5. 1678, at the age of 63, much regretted by his countrymen. The ſenate had appointed him to write the Hiſtory of the Republic; which he executed to the ſatisfaction of the Venetians, although the work was leſs admired by foreigners, who were not proper judges of the accuracy with which he ſtated the facts, of the purity of his diction, nor of the ſimplicity of his ſtyle; although it muſt be acknowledged that his narrative is much interrupted by too frequent parentheſes. In writing his hiſtory of Venice he has given an univerſal hiſtory of his times, eſpecially with reſpect to the affairs of the French in Italy. This hiſtory, which is continued from 1613 to 1671, was printed at Venice in 2 vols 4to, in the years 1662 and 1679.

NAN-KING, a city of China, and capital of the province of King-nan, is ſaid to have been formerly one of the moſt beautiful and flouriſhing cities in the world. When the Chineſe ſpeak of its extent, they ſay, if two horſemen ſhould go out by the ſame gate, and ride round it on full ſpeed, taking different directions, they would not meet before night. This account is evidently exaggerated: but it is certain, that Nanking ſurpaſſes in extent all the other cities of China. We are aſſured that its walls are five leagues and a half in circumference.

This city is ſituated at the diſtance of a league from the river Yang-tſe-kiang: it is of an irregular figure; the mountains which are within its circumference having prevented its being built on a regular plan. It was formerly the imperial city; for this reaſon it was called *Nan-King*, which ſignifies, "the Southern

Nan-king, Nanſio.

Court;" but ſince the ſix grand tribunals have been transferred from hence to Peking, it is called *Kiang-ning* in all the public acts.

Nan-king has loſt much of its ancient ſplendour: it had formerly a magnificent palace, no veſtige of which is now to be ſeen; an obſervatory at preſent neglected, temples, tombs of the emperors, and other ſuperb monuments, of which nothing remains but the remembrance. A third of the city is deſerted, but the reſt is well inhabited. Some quarters of it are extremely populous and full of buſineſs; particularly the manufacture of a ſpecies of cotton cloth, of which great quantities are imported into Europe under the name of *Nankin*. The ſtreets are not ſo broad as thoſe of Peking; they are, however, very beautiful, well-paved, and bordered with rich ſhops.

In this city reſides one of thoſe great mandarins called *Tſong-gtou*, who takes cognizance of all important affairs, not only of both the governments of the province, but alſo of thoſe of the province of Kiang-ſi. The Tartars have a numerous garriſon here, commanded by a general of their own nation; and they occupy a quarter of the city, ſeparated from the reſt by a plain wall.

The palaces of the mandarins, whether Chineſe or Tartars, are in this city neither larger nor better built than thoſe in the capital cities of other provinces. Here are no public edifices correſponding to the reputation of ſo celebrated a city, excepting its gates, which are very beautiful, and ſome temples, among which is the fomous porcelain tower. It is 200 feet high, and divided into nine ſtories by plain boards within, and without by cornices and ſmall projections covered with green varniſhed tiles. There is an aſcent of 40 ſteps to the firſt ſtory; between each of the others there are 21.

The breadth and depth of the river Yang-tſe-kiang formerly rendered the port of Nan-king very commodious; but at preſent large barks, or rather Chineſe junks, never enter it; whether it be that it is ſhut up by ſand-banks, or that the entrance of it has been forbid, in order that navigators may inſenſibly loſe all knowledge of it.

In the months of April and May a great number of excellent fiſh are caught in this river near the city, which are ſent to court; they are covered with ice, and tranſported in that manner by barks kept entirely on purpoſe. Although this city is more than 200 leagues from Peking, theſe boats make ſuch expedition, that they arrive there in eight or nine days. This city, though the capital of the province, has under its particular juriſdiction only eight cities of the third claſs. The number of its inhabitants are ſaid to be 1,000,000, without comprehending the garriſon of 40,000 men. E. Long. 119. 25. N. Lat. 32. 46.

NANSIO, an iſland of the Archipelago, a little to the north of the iſland of Santorino, 16 miles in circumference; but has no harbour. The mountains are nothing but bare rocks, and there are not ſprings ſufficient to water the fields. There are a vaſt number of partridges, whoſe eggs they deſtroy every year to preſerve the corn, and yet vaſt numbers of them are always produced. The ruins of the temple of Apollo are yet to be ſeen, and conſiſt chiefly of marble columns. E. Long. 26. 20. N. Lat. 36. 15.

NANTES, an ancient, rich, and very conſiderable town of France, in Bretagne, with a biſhop's ſee, an univerſity, and a mint. It is one of the moſt conſiderable places in the kingdom; contains the richeſt merchants; and was formerly the reſidence of the dukes of Bretagne, where they built a very ſtrong caſtle on the ſide of the river, and which is ſtrongly fortified. There are ſeveral pariſhes, and a great many religious houſes, and the cathedral contains the tombs of the ancient dukes. There are ſeveral fine bridges over the river Loire, which is navigable. The ſuburbs are ſo large, on account of the number of people that come from all parts to ſettle here, that they exceed the city. The Spaniards trade here with wine, fine wool, iron, ſilk, oil, oranges, and lemons; and they carry back cloth, ſtuffs, corn, and hard-ware. The Dutch ſend ſalt fiſh, and all ſorts of ſpices; and in return have wine and brandy. The Swedes bring copper; and the Engliſh, lead, tin, and pit-coal. It was in this place that Henry IV. promulgated the famous edict in 1598, called the *Edict of Nantes*, and which was revoked in 1685. Nantes was anciently, like almoſt every conſiderable city in Europe, very ſtrongly fortified. Peter de Dreux, one of the dukes of Bretagne, ſurrounded it with walls, which have only been demoliſhed within theſe few years. The bridge is an object of curioſity. It is near a mile and a half in length, being continued acroſs all the little iſlands in the Loire, from north to ſouth. The territory of Nantes lies on both ſides the Loire, and feeds a great number of cattle. Large veſſels can come no higher than Port Launai, which is 12 miles from Nantes. W. Long. 1. 31. N. Lat. 47. 13.

Nantes || Napæa.

NANTUEIL (Robert), the celebrated deſigner and engraver to the cabinet of Louis XIV. was born at Rheims in 1630. His father, though but a petty ſhopkeeper, gave his ſon a liberal education; who, having a taſte for drawing, cultivated it with ſuch ſucceſs, that he became the admiration of the whole town: but marrying young, and not being able to maintain his family, he took a journey to Paris, where he made his talents known by a ſtratagem.—Seeing ſeveral abbés at the door of an eating-houſe, he aſked the miſtreſs for an eccleſiaſtic of Rheims, whoſe name he had forgot, but that ſhe might eaſily know him by a picture of him which he ſhowed: the abbés crowding round, were ſo charmed with it, that he ſeized the opportunity of offering to draw any of their pictures for a ſmall matter. Cuſtomers came ſo faſt, that he ſoon raiſed his price, and brought his family to Paris, where his reputation was quickly eſtabliſhed. He applied himſelf particularly to taking portraits in crayons, which he afterwards engraved for the uſe of academical theſes; and in this way he did the portrait of the king, and afterwards engraved it as big as the life; a thing never before attempted. The king was ſo pleaſed with it, that he created the place of deſigner and engraver to the cabinet for him, with a penſion of 1000 livres. He died in 1678; and an entire collection of his prints amounts to upwards of 240.

NANTWICH. See Namptwich.

NAPÆA, in botany: A genus of the polyandria order, belonging to the polydelphia claſs of plants; and in the natural method ranking under the 37th order, *Columniferæ*. The calyx is ſingle and cylindric; the

Naphtha. the arilli coalited and monoſpermous. There are two ſpecies; both of them with perennial roots, compoſed of many thick fleſhy fibres, which ſtrike deep into the ground, and are connected at the top into large heads; the ſtalks grow to ſeven or eight feet high, producing white flowers, tubulous at bottom, but ſpreading open at top, and dividing into five obtuſe ſegments. Both theſe plants are natives of Virginia and other parts of North America: from the bark of ſome of the Indian kinds a ſort of fine hemp might be procured, capable of being woven into very ſtrong cloth. They are eaſily propagated by ſeed, which will thrive in any ſituation.

NAPHTHA, an inflammable ſubſtance of the bituminous kind, of a light brown colour, and incapable of decompoſition, though frequently adulterated with heterogeneous mixtures. By long keeping it hardens in the air into a ſubſtance reſembling a vegetable reſin; and in this ſtate it is always of a black colour, whether pure or mixed with other bodies. According to Mongez, there are three kinds of naphtha, the white, reddiſh, and green or deep-coloured; and it is in fact a true petrol or rock oil, of which the lighteſt and moſt inflammable is called *naphtha*. It is ſaid to be of an extremely fragrant and agreeable ſmell, though very different in this reſpect from vegetable oils. It is alſo tranſparent, extremely inflammable, diſſolves reſins and balſams, but not gum-reſins nor elaſtic gum. It diſſolves in the eſſential oils of thyme and lavender, but is inſoluble in ſpirit of wine and ether. It burns with a bluiſh flame, and is as inflammable as ether; like which it alſo attracts gold from aqua-regia.

Naphtha, according to Cronſtedt, is collected from the ſurface of ſome wells in Perſia; but Mr Kirwan informs us, that it iſſues out of white, yellow, or black clays, in Perſia and Media. The fineſt is brought from a peninſula in the Caſpian Sea, called by Kempfer *okefra*. It iſſues out through the earth into ciſterns and wells, purpoſely excavated for collecting it at Baku in Perſia. Different kinds of this ſubſtance are alſo found in Italy, in the duchy of Modena, and in Mount Ciaro, 12 leagues from Plaiſance.

The formation of naphtha and petroleum is by moſt naturaliſts and chemiſts aſcribed to the decompoſition of ſolid bitumens by the action of ſubterraneous fires; naphtha being the lighteſt oil, which the fire diſengages firſt; what follows gradually acquiring the colour and conſiſtence of petrol. Laſtly, the petrolea, united with ſome earthy ſubſtances, or altered by acids, aſſume the appearance of mineral pitch, piſſaſphaltum, &c. This opinion ſeems to be ſupported by the phenomena attending the diſtillation of amber; where the firſt liquor that riſes is a true naphtha; then a petroleum of a more or leſs brown colour; and laſtly, a black ſubſtance like jet, which being farther urged by the fire, leaves a dry friable matter, &c. It is further obſerved, that nature frequently produces all the different kinds of petrolea near the ſame ſpot; of which we have an inſtance at Mount Teſtin in the duchy of Modena in Italy. Some, however, are of opinion, that theſe mineral oils or bitumens are formed from the vitriolic acid, and various oily and fat ſubſtances found in the bowels of the earth.

NAPHTHALI, or NEPHTHALI (Joſh. xix.), one of the tribes of Iſrael; having Zabulon on the ſouth, Aſher on the weſt, the Jordan on the eaſt, and on the north Antilibanus. Naphthali, Napier.

NAPIER (John), baron of Merchiſton in Scotland, inventor of the logarithms, was the eldeſt ſon of Sir Archibald Napier of Merchiſton, and born in the year 1550. Having given early diſcoveries of great natural parts, his father was careful to have them cultivated by a liberal education. After going through the ordinary courſes of philoſophy at the univerſity of St Andrew's, he made the tour of France, Italy, and Germany. Upon his return to his native country, his literature and other fine accompliſhments ſoon rendered him conſpicuous, and might have raiſed him to the higheſt offices in the ſtate; but declining all civil employments, and the buſtle of the court, he retired from the world to purſue literary reſearches, in which he made an uncommon progreſs, ſo as to have favoured mankind with ſundry uſeful diſcoveries. He applied himſelf chiefly to the ſtudy of mathematics; but at the ſame time did not neglect that of the Holy Scriptures. In both theſe he hath diſcovered the moſt extenſive knowledge and profound penetration. His eſſay upon the book of the Apocalypſe, indicates the moſt acute inveſtigation, and an uncommon ſtrength of judgment; though time hath diſcovered, that his calculations concerning particular events had proceeded upon fallacious data. This work has been printed abroad in ſeveral languages; particularly in French at Rochelle in the year 1693, 8vo, announced in the title as reviſed by himſelf. Nothing, ſays Lord Buchan, could be more agreeable to the Rochellers or to the Huguenots of France at this time, than the author's annunciation of the pope as antichriſt, which in this book he has endeavoured to ſet forth with much zeal and erudition.—But what has principally rendered his name famous, was his great and fortunate diſcovery of logarithms in trigonometry, by which the eaſe and expedition in calculation have ſo wonderfully aſſiſted the ſcience of aſtronomy and the arts of practical geometry and navigation. That he had begun about the year 1593 the train of enquiry which led him to that great atchievement in arithmetic, appears from a letter to Crugerus from Kepler in the year 1624; wherein, mentioning the *Canon Mirificus*, he writes thus: "Nihil autem ſupra Neperianam rationem eſſe puto: etſi Scotus quidem literis ad Tychonem, anno 1594, ſcriptis jam ſpem fecit Canonis illius mirifici;" which alluſion agrees with the idle ſtory mentioned by Wood in his *Athenæ Oxon.* and explains it in a way perfectly conſonant to the rights of Napier as the inventor.

When Napier had communicated to Mr Henry Briggs, mathematical profeſſor in Greſham college, his wonderful canon for the logarithms, that learned profeſſor ſet himſelf to apply the rules in his *Imitatio Nepeirea*; and in a letter to archbiſhop Uſher in the year 1615, he writes thus: "Napier, baron of Merchiſton, hath ſet my head and hands at work with his new and admirable logarithms. I hope to ſee him this ſummer, if it pleaſe God; for I never ſaw a book which pleaſed me better, and made me more wonder." The following paſſage from the life of Lilly the aſtrologer is quoted by Lord Buchan as giving a pictu-

reſque

Napier. resque view of the meeting betwixt Briggs and the inventor of the logarithms at Merchiſton near Edinburgh. "I will acquaint you (ſays Lilly) with one memorable ſtory related unto me by John Marr, an excellent mathematician and geometrician, whom I conceive you remember. He was ſervant to King James I. and Charles I. When Merchiſton firſt publiſhed his logarithms, Mr Briggs, then reader of the aſtronomy lectures at Greſham college in London, was ſo much ſurpriſed with admiration of them, that he could have no quietneſs in himſelf until he had ſeen that noble perſon whoſe only invention they were: he acquaints John Marr therewith, who went into Scotland before Mr Briggs, purpoſely to be there when theſe two ſo learned perſons ſhould meet. Mr Briggs appoints a certain day when to meet at Edinburgh; but failing thereof, Merchiſton was fearful he would not come. It happened one day as John Marr and the baron Napier were ſpeaking of Mr Briggs; 'Ah, John (ſaid Merchiſton), Mr Briggs will not now come.' At the very inſtant one knocks at the gate; John Marr haſted down, and it proved to be Mr Briggs to his great contentment. He brings Mr Briggs up to the Baron's chamber, where almoſt one quarter of an hour was ſpent, each beholding other with admiration before one word was ſpoken. At laſt Mr Briggs began: 'Sir, I have undertaken this long journey purpoſely to ſee your perſon, and to know by what engine of wit or ingenuity you came firſt to think of this moſt excellent help into aſtronomy, *viz* the logarithms; but, Sir, being by you found out, I wonder nobody elſe found it out before, when now being known it appears ſo eaſy.' He was nobly entertained by baron Napier; and every ſummer after that, during the laird's being alive, this venerable man Mr Briggs went purpoſely to Scotland to viſit him."

Earl of Buchan's Account of the Writings and Inventions of Napier of Merchiſton.

There is a paſſage in the life of Tycho Brahe by Gaſſendi, which may miſlead an attentive reader to ſuppoſe that Napier's method had been explored by Herwart at Hoenburg: It is in Gaſſendi's Obſervations on a Letter from Tycho to Herwart of the laſt day of Auguſt 1599. "Dixit Hervartus nihil morari ſe ſolvendi cujuſquam trianguli difficultatem; ſolere ſe enim multiplicationum, ac diviſionum vice additiones ſolum, ſubtractiones 93 uſurpare (quod ut fieri poſſet, docuit poſtmodum ſuo Logarithmorum Canone Neperus.)" But Herwart here alludes to his work afterwards publiſhed in the year 1610, which ſolves triangles by proſtaphæreſis; a mode totally different from that of the logarithms.

Kepler dedicated his *Ephemerides* to Napier, which were publiſhed in the year 1617; and it appears from many paſſages in his letter about this time, that he held Napier to be the greateſt man of his age in the particular department to which he applied his abilities. "And indeed (ſays our noble biographer), if we conſider that Napier's diſcovery was not like thoſe of Kepler or of Newton, connected with any analogies or coincidences which might have led him to it, but the fruit of unaſſiſted reaſon and ſcience, we ſhall be vindicated in placing him in one of the higheſt niches in the temple of fame. Kepler had made many unſucceſsful attempts to diſcover his canon for the periodic motions of the planets, and hit upon it at laſt, as he himſelf candidly owns on the 15th of May 1618; and Newton applied the palpable tendency of heavy bodies to the earth to the ſyſtem of the univerſe in general; but Napier ſought out his admirable rules by a ſlow ſcientific progreſs, ariſing from the gradual evolution of truth." Napier.

The laſt literary exertion of this eminent perſon was the publication of his *Rabdology and Promptuary* in the year 1617, which he dedicated to the Chancellor Seton; and ſoon after died at Merchiſton on the 3d of April O. S. of the ſame year, in the 68th year of his age and 23d of his happy invention.—The particular titles of his publiſhed works are: 1. A plain diſcovery of the Revelation of St John. 2. *Mirifici ipſius canonis conſtructio et logarithmorum, ad naturales ipſorum numeros habitudines.* 3. *Appendix de alia atque præſtantiore logarithmorum ſpecie conſtituenda, in qua ſcilicet unitas logarithmus eſt.* 4. *Rhabdologiæ, ſeu numerationis per virgulas, libri duo.* 5. *Propoſitiones quædam eminentiſſimæ, ad triangula ſphærica mira facultate reſolvenda.* To which may be added, 6. His Letter to Anthony Bacon (the original of which is in the archbiſhop's library at Lambeth), intitled, "Secret inventions, profitable and neceſſary in theſe days for the defence of this iſland, and withſtanding ſtrangers enemies to God's truth and religion;" which the earl of Buchan has cauſed to be printed in the Appendix to his Account of Napier's Writings. This letter is dated June 2. 1596, about which time it appears the author had ſet himſelf to explore his logarithmic canon.

This eminent perſon was twice married. By his firſt wife, who was a daughter of Sir James Stirling of Keir, he had only one ſon named Archibald, who ſucceeded to the eſtate. By his ſecond wife, a daughter of Sir James Chiſholm of Cromlix, he had a numerous iſſue.—*Archibald Napier*, the only ſon of the firſt marriage, was a perſon of fine parts and learning. Having more a turn to public buſineſs than his father had, he was raiſed to be a privy counſellor by James VI. under whoſe reign he alſo held the offices of treaſurer-depute, juſtice-clerk, and ſenator of the college of juſtice. By Charles I. he was raiſed to the peerage by the title of *Lord Napier*.

Napier's Rods, or *Bones*, an inſtrument invented by Baron Napier, whereby the multiplication and diviſion of large numbers is much facilitated.

As to the Conſtruction of Napier's Rods: Suppoſe the common table of multiplication to be made upon a plate of metal, ivory, or paſteboard, and then conceive the ſeveral columns (ſtanding downwards from the digits on the head) to be cut aſunder; and theſe are what we call *Napier's rods for multiplication*. But then there muſt be a good number of each; for as many times as any figure is in the multiplicand, ſo many rods of that ſpecies (*i. e.* with that figure on the top of it) muſt we have; though ſix rods of each ſpecies will be ſufficient for any example in common affairs: there muſt be alſo as many rods of 0's.

But before we explain the way of uſing theſe rods, there is another thing to be known, *viz.* that the figures on every rod are written in an order different from that in the table. Thus the little ſquare ſpace or diviſion in which the ſeveral products of every column are written, is divided into two parts by a line acroſs from the upper angle on the right to the lower on the left; and if the product is a digit, it is ſet in the

Napier. the lower diviſion; if it has two places, the firſt is ſet in the lower, and the ſecond in the upper diviſion; but the ſpaces on the top are not divided; alſo there is a rod of digits, not divided, which is called the *index rod*, and of this we need but one ſingle rod. See the figure of all the different rods, and the index, ſeparate from one another, in Plate CCCXLIV.

Multiplication by Napier's Rods. Firſt lay down the index-rod; then on the right of it ſet a rod, whoſe top is the figure in the higheſt place of the multiplicand: next to this again, ſet the rod whoſe top is the next figure of the multiplicand; and ſo on in order to the firſt figure. Then is your multiplicand tabulated for all the nine digits; for in the ſame line of ſquares ſtanding againſt every figure of the index rod, you have the product of that figure; and therefore you have no more to do but to transfer the products and ſum them. But in taking out theſe products from the rods, the order in which the figures ſtand obliges you to a very eaſy and ſmall addition: thus, begin to take out the figure in the lower part, or units place, of the ſquare of the firſt rod on the right; add the figure in the upper part of this rod to that in the lower part of the next, and ſo on; which may be done as faſt as you can look on them. To make this practice as clear as poſſible, take the following example.

Example: To multiply 4768 by 385. Having ſet the rods together for the number 4768 (*ibid.* n° 2.) againſt 5 in the index, I find this number, by adding according to the rule, - - - 23840
Againſt 8, this number - - - 38144
Againſt 3, this number - - 14304

Total product - - - 183,680

To make the uſe of the rods yet more regular and eaſy, they are kept in a flat ſquare box, whoſe breadth is that of ten rods, and the length that of one rod, as thick as to hold ſix (or as many as you pleaſe) the capacity of the box being divided into ten cells, for the different ſpecies of rods. When the rods are put up in the box (each ſpecies in its own cell diſtinguiſhed by the firſt figure of the rod ſet before it on the face of the box near the top), as much of every rod ſtands without the box as ſhows the firſt figure of that rod: alſo upon one of the flat ſides without and near the edge, upon the left hand, the index rod is fixed; and along the foot there is a ſmall ledge; ſo that the rods when applied are laid upon this ſide, and ſupported by the ledge, which makes the practice very eaſy; but in caſe the multiplicand ſhould have more than nine places, that upper face of the box may be made broader. Some make the roads with four different faces, and figures on each for different purpoſes.

Diviſion by Napier's Rods. Firſt tabulate your diviſor; then you have it multiplied by all the digits, out of which you may chooſe ſuch convenient diviſors as will be next leſs to the figures in the dividend, and write the index anſwering in the quotient, and ſo continually till the work is done. Thus 2179788, divided by 6123, gives in the quotient 356.

Having tabulated the diviſor 6123, you ſee that 6123 cannot be had in 2179; therefore take five places, and on the rods find a number that is equal or next leſs to 21797, which is 18369; that is, 3 times the diviſor: wherefore ſet 3 in the quotient, and ſubtract 18369 from the figures above, and there will remain 3428; to which add 8, the next figure of the dividend, and ſeek again on the rods for it, or the next leſs, which you will find to be five times; therefore ſet 5 in the quotient, and ſubtract 30615 from 34288, and there will remain 3673; to which add 8, the laſt figure in the dividend, and finding it to be juſt 6 times the diviſor, ſet 6 in the quotient.

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6123)2179788(356
     18369..
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      34288
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Naples. NAPLES, a kingdom of Italy, comprehending the ancient countries of Samnium, Campania, Apulia, and Magna Græcia. It is bounded on all ſides by the Mediterranean and Adriatic, except on the north-eaſt, where it terminates on the Eccleſiaſtical ſtate. Its greateſt length from ſouth-eaſt to north-weſt is about 280 Engliſh miles; and its breadth from north-eaſt to ſouth-weſt, from 96 to 120.

The ancient hiſtory of this country falls under the articles Rome and Italy; the preſent ſtate of it, as well as of the reſt of Italy, is owing to the conqueſts of Charlemagne. When that monarch put an end to the kingdom of the Lombards, he obliged the dukes of Friuli, Spoleto, and Benevento, to acknowledge him as king of Italy; but allowed them to exerciſe the ſame power and authority which they had enjoyed before his conqueſt. Of theſe three dukedoms Benevento was by far the moſt powerful and extenſive, as it comprehended almoſt all the preſent kingdom of Naples; that part of Farther Calabria beyond the rivers Savuto and Peto, a few maritime cities in Hither Calabria, with the city of Acripoli, and the promontory in its neighbourhood called *Capo di Licoſa*; and laſtly, the dukedoms of Gaeta, Naples, and Amalfi, which were very inconſiderable, and extended along the ſhore only about 100 miles, and were interrupted by the Gaſtaldate or county of Capua.

1 Extent of the duchy of Benevento.

This flouriſhing and extenſive dukedom was at this time governed by Arechis, who had married one of the daughters of the laſt king of the Lombards, and had ſubmitted, and taken the oath of allegiance to the emperor Charles. However, a few years after, he renounced his allegiance to the Franks, declared himſelf an independent ſovereign, and was acknowledged as ſuch by all the inhabitants of his duchy. To ſtrengthen himſelf againſt Pepin king of Italy, who reſided at Ravenna, he enlarged and fortified the city of Benevento, and likewiſe built Salerno on the ſea-coaſt, ſurrounding it with a very ſtrong and high wall. He engaged in ſeveral wars with the Greeks, whom he ſometimes obliged to give him hoſtages; but having invaded the territories of the pope, whom Pepin could not aſſiſt, Charlemagne was prevailed on to return to Italy. Arechis, unable to oppoſe ſuch a formidable enemy, ſent his eldeſt ſon, Romuald, to Rome, with an offer of ſubmiſſion: but, at the inſtigation of the pope, Charles refuſed the

2 Arechis duke of Benevento revolts from Charlemagne.

Nap'es. offer, and detained his ſon priſoner; after which he ravaged the country, and made himſelf maſter of Capua. Other deputies, however, proved more ſucceſsful; and, in the year 787, a peace was concluded on theſe conditions: That Arechis and the Beneventans ſhould renew their allegiance to the Franks; that he ſhould pay a yearly tribute to Pepin; deliver up all his treaſure; and give his ſon Grimoald and his daughter Adelgiſa, with twelve others, as hoſtages for his fidelity: however, after many intreaties, Adelgiſa was reſtored to her father.

3 Submits.

4 Revolts a ſecond time.

Charles had no ſooner left Italy, than Arechis forgot all his engagements, and began to negociate with Irene, empreſs of Conſtantinople, and her ſon Conſtantine, for expelling the Franks out of Italy. For himſelf, he deſired the honour of patriciate, and the dukedom of Naples with all its dependencies; and, in return, promiſed to acknowledge the Greek emperor as his ſovereign, and to live after the manner of the Greeks. He required, however, to be ſupported by a Greek army; and that his brother-in-law Adalgiſus, ſon to Deſiderius the laſt king of the Lombards, ſhould be ſent over into Italy, to raiſe a party among his countrymen. Theſe conditions were readily accepted, on condition that prince Romuald ſhould be ſent as an hoſtage; ambaſſadors were ſent to Naples with the enſigns of the patrician order, namely the mantle of cloth of gold, the ſword, the comb, and the ſandals: but before the ceremony could be performed, prince Romuald died, and ſoon after him his father; whoſe death was ſuppoſed to have been haſtened by that of his ſon.

After the death of Arechis, the Beneventans ſent a moſt ſubmiſſive embaſſy to Charlemagne, intreating him to ſend them Grimoald, the late king's ſon, and only lawful heir to his crown; threatening at the ſame time to revolt if their prince was denied them. Charles readily granted their requeſt, and allowed Grimoald to depart, after he had agreed to the following conditions, viz. That he ſhould oblige the Lombards to ſhave their beards; that, in writings, and on money, the name of the king ſhould be put before that of the prince; and that he ſhould cauſe the walls of Salerno, Acerenza, and Conſia, to be entirely demoliſhed.—The new king was received by his ſubjects with the utmoſt joy; and for ſome time continued faithful to his engagements, excepting only the laſt article, which he either neglected or eluded. So far, however, was he from aſſiſting the Greeks, that he gave notice of their machinations to Pepin king of Italy; raiſed an army to oppoſe his uncle Adalgiſus; and being joined by Hildebrand duke of Spoleto, and Vinigiſe the general of Pepin, he attacked the Greeks in Calabria ſoon after they had landed, entirely defeated and took his uncle priſoner, and, as is ſaid, put him to a cruel death. Yet in a ſhort time Grimoald contracted an alliance with the Greek emperor by marrying his neice Wanzia; and in the fifth year of his reign a war broke out between him and Pepin, which continued for twelve years; at the end of which time a truce was concluded. Grimoald ſurvived this pacification only three years, and was ſucceeded by his treaſurer Grimoald II. who ſubmitted to Charlemagne after the death of Pepin; and from this time the Beneventans were looked upon as tributaries of the weſtern emperors.

5 Grimoald continues for ſome time faithful to the Franks.

Nap'es. As yet, however, the city of Naples did not own allegiance to the dukes of Benevento, but was held by the eaſtern emperors; and frequent wars took place between the Beneventans and Neapolitans. This happened to be the caſe when Grimoald II. aſcended the throne. He concluded a peace with them; which however, was of no long continuance; for Theodore, governor of Naples, having granted protections to Dauferius a noble Beneventan, who had been concerned in a conſpiracy againſt his prince, Grimoald marched againſt the city of Naples, and inveſted it by ſea and land. Theodore ſtill refuſed to deliver up the traitor, and a general engagement both by land and ſea was the conſequence; in which the Neapolitans were defeated with ſo great ſlaughter, that the ſea was ſtained with their blood for more than ſeven days. Theodore then conſented to deliver up Dauferius, with 8000 crowns for the expences of the war; and Grimoald not only pardoned Dauferius, but received him into favour: the traitor, however, reflecting on the heinouſneſs of his crime, was ſeized with remorſe; and went a pilgrimage to the holy land, carrying a large ſtone in his mouth, by way of penance, which he never took out but at his meals.

6 Is murdered, and ſucceeded by Sico.

In the year 821, Grimoald was murdered by Radelchis count of Conſia, and Sico gaſtald of Acerenta, the latter of whom ſucceeded to the dukedom of Benevento. Radelchis being ſoon after ſeized with remorſe, became a monk; while Sico aſſociated his ſon Sicardo with him in the government; and both, being of an ambitious and reſtleſs diſpoſition, ſought a pretence for attacking the Neapolitans. This was ſoon found, and the city was inveſted by ſea and land. The walls were furiouſly battered; and part of them being beat down, Sico prepared for a general aſſault. Stephen, at that time duke of Naples, pretended to ſubmit; but, that he might prevent the city from being pillaged, intreated Sico to put off his entry till the morning, and in the mean time ſent out his mother and his two children as hoſtages. Sico conſented to his requeſt; but next morning found the breach built up, and the Neapolitans prepared for their defence. Exaſperated at their perfidy, he renewed his attacks with vigour, but without any ſucceſs; the beſieged defending themſelves with the utmoſt obſtinacy. At laſt, perceiving that they ſhould not be able to hold out much longer, they conſented to a peace on the following conditions, viz. That the Neapolitans ſhould pay an annual tribute to the princes of Benevento, and conſent to the tranſporting of the body of St Januarius from his church without the walls of Naples to Benevento. Theſe conditions being ratified, Sico returned with great honour to Benevento; but ſoon after renewed the war, under pretence that the Neapolitans had neglected to pay the ſtipulated ſum; and hoſtilities continued till his death, which happened in 833.

7 Naples beſieged by Sico;

8 And by his ſucceſſor Sicardo.

Sico was ſucceeded in the government of Benevento by his ſon Sicardo, who had married the daughter of Dauferius; and being influenced by the evil counſels of Roffrid his wife's brother, oppreſſed his ſubjects to ſuch a degree that they conſpired againſt his life. He beſieged Naples with a powerful army, and took poſſeſſion of Acerra and Atella, both of which he fortified. But Bonus, the Neapolitan duke, defended himſelf

Naples. himself so vigorously, that the Beneventans were obliged to retire, and even to abandon Acerra and Atella, the fortifications of which were immediately demolished. At last Sicardo agreed to a peace for five years, on the intercession of Lothaire, emperor and king of Italy; but his chief motive was thought to have been the fear of the Saracens, whom the duke of Naples had called over from Africa to his assistance: for no sooner were they sent back than Sicardo attempted to delay the conclusion of the treaty; but the emperor interposing his authority, a peace was concluded in the year 836, after the war had continued, with very little intermission, for 16 years.

9 The Saracens called in by the duke of Naples.

Soon after the conclusion of this peace, the Saracens landed at Brindisi; and having made themselves masters of the place, ravaged all the neighbouring country. Sicardo marched against them with a numerous army; but the Saracens having dug a great number of ditches which they slightly covered over, found means to draw the Beneventans in among them, whereby they were repulsed with great loss. However, Sicardo, having reinforced his army, marched again to attack them; but the Saracens, despairing of success, pillaged and burnt Brindisi, and then retired with their booty, and a great many captives, to Sicily. Sicardo then, without any apparent provocation, attacked the city of Amalfi, levelled its walls with the ground, carried off all its wealth, and the body of its tutelar saint Triphomen. A great many of the inhabitants were transported to Salerno; and by promoting alliances between the inhabitants of both places, he endeavoured to unite Amalfi to his own principality as firmly as possible.

10 Sicardo murdered by Radelchis, which brings on a civil war.

During all these transactions, Sicardo had tyrannized over his subjects in such a manner, that at last he became intolerable. Among other acts of injustice, he imprisoned his own brother Siconolphus; compelled him to turn priest; and afterwards sent him bound to Tarento, where he caused him to be shut up in an old tower that had been built for a cistern. By such acts of tyranny his nobles were provoked to conspire against him; and in the year 839 he was murdered in his tent.

On the death of Sicardo, Radelchis, his secretary or treasurer, was unanimously elected prince of Benevento; but Siconolphus, the last king's brother, having regained his liberty, formed a great party against the new prince. Radelchis did not fail to oppose him with a formidable army; and a most ruinous civil war ensued. Both parties by turns called in the Saracens; and these treacherous allies acted sometimes against one, and sometimes against the other; or turned their arms against both, as seemed most suitable to their own interest. Thus the war continued with the utmost animosity for 12 years, during which time the principality was almost entirely ruined; till at last the emperor Lewis interposed, and obliged the competitors to agree to a partition of the principality.

11 The principality divided.

By this treaty, Radelchis promised to acknowledge Siconolphus and his successors as lawful princes of the principality of Salerno, which was declared to contain Tarento, Latiniano, Cassano, Cossenzo, Laino, Lucania, Consia, Montella, Rota, Salerno, Sarno, Cirateriurn, Furculo, Capua, Feano, Sora, and the half of the Gastaldate of Acerenza, where it joins Latiano and Consia. The boundary betwixt Benevento and Capua was fixed at St Angelo ad Cerros; Alli Peregrini was made the boundary betwixt Benevento and Salerno, and Staffilo betwixt Benevento and Consia. The monasteries of Monte Cassino and St Vincent were declared to be immediately under the protection of the emperor: both princes stipulated that no hostilities should be committed by either against the subjects of each other; and promised to join their forces in order to drive out the Saracens. Soon after this pacification, however, both Radelchis and Siconolphus died; the former appointing his son Radelgarius, or Radelcar, to succeed him; and the latter leaving an infant son, Sico, to the care of his godfather, Peter. Naples.

12 Unsuccessful war with the Saracens.

The war with the Saracens proved very unsuccessful; neither the united efforts of the princes, nor the assistance of the emperor Lewis himself, being able to expel the infidels; and, in 854, Adelgise the second son of Radelchis, who had now succeeded, on the death of his brother Radelcar, to the principality of Benevento, was obliged to pay them an annual subsidy. Two years after, Lando, count of Capua, revolted from the prince of Salerno, and could not be reduced. In the mean time, Sico, the lawful prince of Salerno, had been poisoned by Count Lando, and the principality usurped by Ademarius, the son of Peter above mentioned; but in 861, Ademarius himself was seized and imprisoned by Gauferius, the son of Dauferius formerly mentioned. This was occasioned by his cruelty and rapaciousness, which entirely alienated the hearts of his subjects from him, and encouraged Gauferius to become the head of the conspirators. The Saracens in the mean time committed terrible ravages throughout the Beneventan territories; which at last obliged Adelgise to enter into an alliance with Gauferius, and both together sent a most humble embassy to the emperor Lewis, requesting him to take them under his protection. About the same time an embassy arrived from Constantinople, proposing a junction of the forces of the eastern and western empires against the infidels; upon which Lewis gave orders for assembling a formidable army. But in the mean time Adelgise fell off from his alliance, and made peace with the Saracens; nay, according to some, he encouraged them in their incursions, and it was at his desire that they invaded the duchy of Capua, and afterwards that of Naples, which they ravaged in a most barbarous manner. The Neapolitans, in conjunction with the duke of Spoleto and the count of Marsi, endeavoured to oppose them; but being defeated, the Saracens continued their ravages with redoubled fury, and retired to Bari, which was their capital city, with an immense booty.

In 866, Lewis arrived at Sora with his army; and having marched to Capua, was there joined by Landulph, the bishop and count, with a body of Capuans: but Landulph soon after persuading his countrymen to desert, Lewis marched against that city, which he took after a siege of three months, and almost totally destroyed. In the end of the year he was joined by Guaferius with his quota of troops, having ordered the eyes of Ademarius to be put out in his absence. Lewis confirmed him in the principality, and marched with his army to Benevento, where Adelgise received

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13 They are at laſt expelled,

14 But ſoon return.

In the year 873, Lewis being abſolved from his oath by the pope, went to Benevento, and was reconciled to Adelgiſe; but ſoon after this reconciliation he died, and the Saracens continued their ravages to ſuch a degree that the inhabitants of Bari were conſtrained to deliver up their city to the Greeks. At the ſame time, the Salernitans, Neapolitans, Cajetans, and Amalfitans, having made peace with the Saracens, were compelled to agree to their propoſal of invading the territories of the Roman pontiff. His holineſs exerted himſelf to the utmoſt, both with ſpiritual and temporal weapons, in order to defend his right; but was at laſt reduced to the neceſſity of becoming a tributary to the infidels, and promiſing to pay them a large ſum annually.

15 The pope becomes their tributary.

In the mean time, all Italy was thrown into the greateſt confuſion by the death of Charles the Bald, who died of poiſon at Pavia, as he was coming to the pope's aſſiſtance. Sergius duke of Naples continued a firm friend to the infidels; nor could he be detached from their intereſts even by the thunder of a papal excommunication: but unluckily happening to fall into the hands of his brother Athanaſius biſhop of Naples, the zeal of that prelate prompted him to put out his eyes, and ſend him a cloſe priſoner to Rome; for which the higheſt encomiums were beſtowed on him by the holy father.

In 876, Adelgiſe was murdered by two of his nephews; one of whom, by name *Gaideris*, ſeized the principality. About the ſame time Landulph biſhop of Capua dying, a civil war enſued among his children, Naples. though their father's dominions had been divided among them according to his will. The princes of Salerno and Benevento, the duke of Spoleto, and Gregory the Greek governor of Bari and Otranto, took different ſides in the quarrel, as they thought moſt proper; and to complete the confuſion, the new biſhop was expelled, and his brother, though a layman, choſen to that office, and even conſecrated by the pope, who wrote to Gauferius, forbidding him to attack Capua under pain of excommunication. But though Gauferius was, in general, obedient to the pope's commands, he proved refractory in this particular, and laid ſiege to Capua for two years ſucceſſively.

Thus the Capuan territories were reduced to the moſt miſerable ſituation; being obliged to maintain at the ſame time the armies of the prince of Benevento and the duke of Spoleto. The Saracens, in the mean time, took the opportunity of ſtrengthening themſelves in Italy; and Athanaſius, notwithſtanding the great commendations he had received from the pope for putting out his brother's eyes, conſented to enter into an alliance with them, in conjunction with whom he ravaged the territories of the pope, as well as thoſe of Benevento and Spoleto, plundering all the churches, monaſteries, towns, and villages, through which they paſſed. At the ſame time the prince of Salerno was obliged to grant them a ſettlement in the neighbourhood of his capital; the duke of Geeta invited them to his aſſiſtance, being oppreſſed by the count of Capua; and even the pope himſelf was obliged to make peace with them, and to grant them a ſettlement on the north ſide of the Carigliano, where they fortified themſelves, and continued for more than 40 years.

To put a ſtop to the confuſion which reigned in Italy, the pope now thought proper to reſtore the biſhop of Capua, who had been expelled, but allowed his brother to reſide in the city, and govern one half of the dioceſe; but notwithſtanding this partition, the civil diſſenſions continued with the utmoſt violence, the neareſt relations murdering or baniſhing each other, according as the fortune of the one or the other prevailed.—Athanaſius, notwithſtanding all the pope's remonſtrances, continued his alliance with the Saracens; in conjunction with whom he ravaged the territory of Benevento, and fomented the diviſions in Capua, in hopes of being able to make a conqueſt of it. At laſt his holineſs thought proper to iſſue a ſentence of excommunication againſt him: but this attached him to the Saracens more than ever; inſomuch that he ſent to Suchaim, king of the Saracens in Sicily, deſiring him to come over and command a great body of his countrymen who had ſettled at the foot of Mount Veſuvius. Suchaim accepted the invitation, and immediately turned his arms againſt Athanaſius; allowing his troops to live at diſcretion in the territory of Naples, where they raviſhed the women, and plundered the inhabitants. Theſe calamities were, by the ſuperſtitious Neapolitans, imagined to be a conſequence of the ſentence of excommunication; and therefore they uſed their utmoſt endeavours to perſuade the prelate to conclude a league with ſome Chriſtian prince, and renounce all connection with the infidels. In this they at laſt proved ſucceſsful, and Athanaſius concluded an alliance with Guaimarius prince of Salerno;

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no; in consequence of which the Saracens were obliged to quit the Neapolitan territories, and retire to Agropoli. Athanasius then directed his force against Capua, of which he made himself master in the year 882. The Saracens, however, still continued their incursions, and ravaged several provinces in such a manner, that they became entirely desolate.

These confusions continued for a long time; during which the Greeks found an opportunity of making themselves masters of Benevento, and had well nigh become masters also of Salerno; but in this they failed through the treachery of the bishop, and in the year 896 they were totally expelled by the bishop, four years after they had become masters of it. In 915 the Saracens received such an overthrow at Carigliano, that scarce one of them remained. However, a new body soon arrived from Africa, and invested the sea-coasts for some time longer. A war also ensued between Landulph and the Greeks; which concluded disadvantageously for the former, who was obliged to submit to the emperor of Constantinople in 943.

16 The Saracens almost entirely cut off.

In 961, Otho the Great, king of Germany, invaded Italy with a powerful army against Berengarius III. and, marching to Rome, received the imperial crown from the hands of the Pope. In 964, he erected Capua into a principality, received homage from the other princes of Lombardy, and formed a design of recovering Puglia and Calabria from the Greeks. But in this last scheme he failed; and after various hostilities a treaty was concluded, and the young princess Theophania married to Otho's son, afterwards emperor.

All this time the Saracens continued their incursions; and the Greeks had gained ground so much, that they were now in possession of two thirds of the present kingdom of Naples; but in the year 1002 or 1003, the Normans first began to be remarkable in Italy. They had, about a century before, embraced Christianity, and become very zealous in all the superstitions which were then practised. They were particularly zealous in visiting sacred places, especially Rome, and the holy sepulchre at Jerusalem; and being naturally of a very martial disposition, they forced through great bodies of Greeks and Saracens who opposed their passage. About this time 40, or, as others write, 100, of these Normans, returning from Jerusalem by sea, landed at Salerno in the habit of pilgrims, where they were honourably received by Guaimarius. During their residence at Salerno, a great body of Saracens landed, and invested the city. Guaimarius, not being in a condition to oppose the invaders by force, was preparing to pay them a large sum of money, which they demanded, when the Normans proposed to attack them; and, having got arms and horses from the prince, they engaged the infidels with such fury and bravery, that they entirely defeated them, and obliged them to fly to their ships. By this complete victory Guaimarius was filled with such admiration of the valour of these strangers, that he entreated them to remain in his country; offering them lands, and the most honourable employments: but not being able to prevail with them to stay in Italy, or even accept of his presents; at their departure he sent some ambassadors with them to Normandy, in vessels loaded with exquisite fruits, rich furniture for horses, &c.

17 The Normans first known in Italy.

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in order to allure the valiant Normans to leave their own country. This kind invitation encouraged a Norman chief, named *Osmond Drengot*, to settle in Italy about the year 1015; having killed another lord in a duel, which obliged him to leave his own country, in order to avoid the resentment of his sovereign, Robert duke of Normandy. In the mean time, the city of Bari had revolted from the Greeks, and chosen one Mello for their leader, whose wife and children happened soon after to fall into the hands of their enemies, and were sent prisoners to Constantinople. No sooner, therefore, did Mello hear of the arrival of these adventurers, than he engaged them to assist him; and having drawn together a considerable army, defeated the Greeks with great slaughter, and obliged them to abandon their camp. In this engagement the Normans distinguished themselves by their bravery; and the news of their success soon brought from Normandy an innumerable multitude of their countrymen, with their wives and children. By this reinforcement, Mello gained two other victories, took a great many towns, and obliged the Greeks to abandon a large territory; but, in 1019, they were utterly defeated, and every thing recovered by the Greeks. The Greek general, Bajanus, continued to go on with such surprising success, that he almost entirely re-established the affairs of his countrymen in Italy, and made a distinct province of the western part of Puglia, which he called *Capatanata*, and which to this day retains the name of *Capitanata*. His great progress at last alarmed the emperors of Germany; and, in 1027, Pandulphus prince of Capua made himself master of Naples; but was obliged, three years afterwards, to leave it, by the Normans, who built the city of Aversa, which was now erected into a county. In consequence of this piece of good fortune, great numbers of Norman adventurers migrated into Italy; among whom were William, Drogo, and Umbert, three of the sons of Tancred duke of Hautville; from whose posterity those princes were descended, who first conquered the island of Sicily from the Saracens, and formed the present kingdom of Naples.

18 They return and defeat the Greeks.

19 But are at last defeated by them.

In 1040, the Greek emperor Michael Paleologus, in order to secure the affection of his fickle subjects, undertook the conquest of Italy from the Saracens, and for that purpose sent a general named *Michael Maniacus* into Sicily. This commander, hearing of the great reputation of the Normans, sent to Guiamarius, prince of Salerno, intreating him to grant him some of those warriors. His request was most willingly hearkened to by the prince of Salerno, who, to encourage the Normans to engage in the expedition, promised them some additional rewards besides the emperor's pay. William, Drogo, and Umbert, accordingly marched from Salerno with 300 of their countrymen; and passing over into Sicily, distinguished themselves most remarkably in the conquest of that island. Maniacus acknowledged, that the recovery of Messina was chiefly owing to their valour; and William with his Normans gained a complete victory over the Saracens before Syracuse, where he killed the governor of the city in single combat. Maniacus made himself master of Syracuse, and almost entirely reduced the whole island; but being accused of treason, was next year carried prisoner to Constantinople. His successor Doceanus,

20 The Normans pass over into Sicily.

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being a man of no abilities, quickly loſt the whole iſland except Meſſina, and treated his Norman auxiliaries with the utmoſt contempt. He would not allow them any ſhare of the booty; and even cauſed one Ardoin, a noble Lombard, and aſſociate and interpreter of the Normans, to be whipped round the camp, becauſe he refuſed to part with the horſe of a Saracen whom he had ſlain in ſingle combat. The conſequences of this tyrannical behaviour were very fatal to the Greeks. Ardoin ſoon after obtained leave to return to Italy under pretence of a vow, and all the Normans embarked at night along with him; but inſtead of going to Rome, Ardoin went immediately to Averſa, where he perſuaded count Rainulphus, ſovereign of that province, to join with him in the deſign he had formed of attacking the Greek provinces in Italy, which, he ſhowed him, would be an eaſy conqueſt, as the inhabitants ſubmitted with great reluctance to the Greeks, and the provinces were at that time almoſt entirely defenceleſs. Rainulphus approved of the ſcheme, and raiſed 300 ſoldiers, whom he ſent under 12 officers, to join the other Normans under the ſons of Tancred; and made an agreement with Ardoin, that the conqueſts ſhould be equally divided among the chief leaders. Their firſt enterpriſe was the reduction of Melphis, one of the ſtrongeſt cities in Puglia, which preſently ſurrendered; and they increaſed its fortifications ſo much, that it thenceforth became impregnable. Soon after this they made themſelves maſters of Venoſa, Aſcoli, and Lavello, with very little oppoſition. Doceanus, alarmed with the rapidity of their conqueſts, immediately left Sicily, and marched with his army into Puglia, where he attacked the invaders near the river Oliviento; but after a fierce engagement, he was obliged to retire with conſiderable loſs. The Greeks were ſoon after defeated a ſecond time at Cannæ; and in a third engagement, which happened near the river Ofanto, the army of Doceanus was entirely routed, and he himſelf obliged to fly to Bari. On this bad ſucceſs Doceanus was ordered to return to his command in Sicily, and another general was ſent with an army into Puglia. This new commander, however, had no better ſucceſs than his predeceſſor; for his army was entirely defeated in an engagement with the Normans, and he himſelf taken priſoner. Atenulphus, brother to one of the princes of Benevento, on whom the Normans had conferred the chief command, ſet at liberty the captive general without conſulting them, on receiving from him a conſiderable ſum of money. With this the Normans were ſo much diſpleaſed, that they deprived Atenulphus of his command, and beſtowed it on Argyrus, ſon to the late Mello, who had eſcaped from Conſtantinople, and now aſſumed the title of *duke and prince of Italy*. Before this time alſo Maniacus, whom we have formerly mentioned, had returned to Italy; and to ſtrike the greater terror into the revolted cities, had executed a number of people of all ages and ſexes with great inhumanity. Soon after this Maniacus openly rebelled againſt the Greek emperor Conſtantinus, and prevailed upon his own army to proclaim him emperor, beginning hoſtilities immediately againſt the Greek cities. Argyrus at the ſame time took Giovenazzo and beſieged Trani, and ſoon after beſieged Maniacus himſelf in Tarento; but he, being afraid of falling into the hands of the Normans, fled to Otranto, and from thence to Bulgaria, where, being entirely defeated by one of the emperor's generals, he was taken priſoner, and had his head ſtruck off.

21 Their conqueſts.

The Normans having now conquered the greateſt part of Puglia, proceeded to make a diviſion of their conqueſt, in which, after each commander had got his proper ſhare, the city of Melfis was left common to all, and appropriated as a place for aſſembling to conſult about the moſt important affairs of the nation. Argyrus alone was neglected in this diviſion; but he, having gained the favour of the emperor by expelling the rebel Maniacus from Italy, was by him created duke of Bari, on purpoſe to check the power of the Normans, with the title of *prince and duke of Puglia*. The Normans, however, were too powerful to be much awed by Argyrus, and behaved with great inſolence to the neighbouring princes; but as they could not be expelled by force, and were confirmed in their conqueſts by Henry II. emperor of Germany in 1047, the Greek emperor attempted to get rid of them, by ſending Argyrus with large ſums of money to bribe them to enter into his ſervice againſt the Perſians. But they, perceiving the ſnare, replied, that they were reſolved not to leave Italy unleſs they were expelled by force; upon which Argyrus made uſe of the ſame money in bribing the Puglians to aſſaſſinate theſe invaders. This brought on a maſſacre, in which greater numbers of Normans periſhed than had fallen in all the late wars. Argyrus attempted to take advantage of the confuſion produced by this maſſacre, but was defeated; after which he had recourſe to Pope Leo, beſeeching him to deliver Italy from theſe cruel tyrants: but this ſcheme proved ſtill more unſucceſsful than the others had been; for the pope himſelf was defeated and taken priſoner; and, in conſequence of the reſpect ſhowed him by the Normans, granted them, as a fief of the holy ſee, all the conqueſts they had made or ſhould make in Calabria and Sicily.

22 Great numbers of them maſſacred.

23 They are confirmed by the pope in all their conqueſts.

Soon after this, the Norman power became extremely formidable; the famous Robert Guiſcard aſcended the throne in 1056. He made great progreſs in the conqueſt of Calabria, and reduced moſt of the cities which held for the Greeks in theſe parts. About the ſame time the counts of Capua were expelled from their territory; and the abbot Deſiderius mentions his having ſeen the children of Landulphus V. the laſt count, going about as vagabonds, and begging for their ſupport. The pope, alarmed by theſe conqueſts, excommunicated the Normans in wholeſale, pretending that they had ſeized ſome of the territories belonging to the church; but, by the pretended ſubmiſſion of Robert, he not only was perſuaded to take off the ſentence of excommunication, but to inveſt him with the provinces of Apulia, Calabria, and Sicily. After this, he continued the war againſt the Greeks with great ſucceſs. In 1071, in conjunction with his brother Roger, he conquered the iſland of Sicily, and gave the inveſtiture of the whole iſland to him with the title of *count*, reſerving to himſelf only the half of Palermo, Meſſina, and the valley of Demona. The like ſucceſs attended his arms againſt Salerno in 1074; but after this, having unadviſedly taken ſome places from the pope, he again fell under the ſentence of excommunication; yet he was reconciled to him in 1080, and

24 Sicily conquered by Robert Guiſcard.

Naples. received a second time the investiture of all his dominions. The next year he undertook an expedition against the Greeks; and though the emperor was assisted by a Venetian fleet, Robert made himself master of the island of Corfu, reduced Durazzo, and great part of Romania; insomuch that by the success of his arms, and his near approach to Constantinople, he struck an universal terror among the Greeks. But while Robert was thus extending his conquests, he was alarmed by the news of a formidable rebellion in Italy, and that the emperor Henry had taken the city of Rome, and closely shut up the pope in the castle of St Angelo. Robert therefore, leaving the command of the army to his son Boemund, returned to Italy, where he immediately dispersed the rebels, and released the pope, while his son gained a considerable victory over the Greeks. After this Robert made great preparations for another expedition into Greece, in order to second his son Boemund. Alexius Comnenus, who was about this time declared emperor by the Greek army, being assisted by the Venetian fleet, endeavoured to oppose his passage; but was entirely defeated, with the loss of a great many galleys. But a final stop was now put to his enterprises by his death, which happened in the island of Corfu in 1085.

Though the power of the Normans was thus thoroughly established in Italy and Sicily, and though the prince of Benevento was in 1130 invested by the the pope with the title of king of Sicily; yet by reason of the civil dissensions which took place among themselves, and the general confusion which reigned in Italy in those ages, they were obliged, notwithstanding all their valour, to submit to the emperor in 1195. By him the Sicilians were treated with so great cruelty, that the empress Constantia was induced to conspire against him in 1197, took him prisoner, and released him only on condition of his sending off his army immediately for the Holy Land. This was complied with; but the emperor did not long survive the reconciliation, being poisoned, as was supposed, by order of the empress.

25 And by the emperor of Germany.

In 1254 the pope claimed the kingdom as a fief devolved on the church in consequence of a sentence of deposition pronounced against king Frederic at the council of Lyons; and, in 1263, the kingdom was, in consequence of this right, conferred on Charles count of Anjou. After much contention and bloodshed, the French thus became masters of Sicily and Naples. Their government was insupportably tyrannical; and at the same time the haughtiness of their king so provoked the pope, that he resolved to humble him.—Charles had resolved on an expedition against Constantinople; and for this purpose had fitted out a fleet of 100 galleys, 30 large ships, 200 transports, besides many other smaller vessels, on board of which he intended to embark 10,000 horse, and a numerous army of foot. This formidable armament greatly alarmed the emperor Michael Paleologus; for which reason he entered into a negociation with John di Procida, a noble Salernitan, lord of the isle of Procida in the bay of Naples, who had formed a scheme for a general revolt in the island of Sicily. John, though a nobleman, was also a physician, and had been counsellor to two former princes, and even to king Charles himself; but being stripped of his estate by the king under pre-

26 The French become masters of Sicily and Naples.

tence of treason, and his wife being debauched by the French, he retired to Constantia queen of Arragon, where he was created a baron of the kingdom of Valencia, by her husband king Peter, and Lord of Luxen, Bénizzano, and Palma. As he was greatly exasperated against the French, he employed many spies both in Puglia and Sicily; and being informed that the Sicilians were totally disaffected to the French, he came to the island in disguise, and concerted a plan with the most powerful of the malcontents for a revolution in favour of Constantia, though she derived her right only as being the daughter of a former usurper named *Manfred*. Procida then set out for Constantinople, where, in some private conferences with the emperor, he persuaded him, that the most probable means of defeating Charles's scheme was by assisting the Spaniards and Sicilian malcontents. Paleologus accordingly granted him a large sum of money, and on his departure sent one of his secretaries along with him, who, landing in Sicily, had a conference with the chief conspirator. John, having received letters from them, disguised himself in the habit of a Franciscan, and went to Suriano in the neighbourhood of Rome. As he well knew the enmity which subsisted between the pope and king Charles, he disclosed his design to his holiness; who readily entered into his measures, wrote to Peter to hasten his armament, promising him the investiture of the island as soon as he had taken possession of it; and, by refusing the assistance he had promised to Charles, obliged him for the present to delay his expedition. In the beginning of the year 1280, Procida returned to Arragon, and by showing the letters from the pope and Sicilian barons, prevailed on Peter to embark in his design, by assuring him of the assistance of Paleologus. The king of Arragon accordingly prepared a formidable fleet under pretence of invading Africa, and is even said to have received 20,000 ducats from Charles, in order to assist him in his preparations.

But while John went on thus successfully with his scheme, all his measures were in danger of being broke by the death of pope Nicholas. The new pope, Martin IV. was entirely in the interest of Charles, on whom, in 1281, he conferred the senatorial dignity of Rome. Procida, however, still resolved to prosecute his scheme; and, leaving Italy, had another conference with the conspirators in Sicily; after which, he again went to Constantinople, and obtained from Paleologus 30,000 ounces of gold, with which he immediately returned to Arragon. The death of Nicholas had damped the ardour of Peter; but, being urged with great earnestness by John, he again renewed his preparations; which alarmed the pope and the king of France. In consequence of this they sent a message to him, desiring to know against what Saracens he designed to employ his armament. In this particular Peter refused to satisfy them; upon which they earnestly counselled Charles to guard against an invasion: but he neglected their advice, being wholly intent on his eastern expedition, and encouraged by a revolt which had happened in Greece; and to facilitate his expedition, he prevailed on the pope to excommunicate the Greeks, on pretence that they had broken some of the articles of union concluded at the council of Lyons a few years before. Peter in the mean time continued

his

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his preparations with great diligence, intending to put to ſea the following ſummer. Procida had returned to Palermo, to wait for a favourable opportunity of putting his deſign in execution, which was ſoon afforded him by the French. On Eaſter Monday, March 30th, 1282, the chief conſpirators had aſſembled at Palermo; and, after dinner, both the Palermitans and French went in a grand proceſſion to the church of Monreale, about three miles without the city. While they were ſporting in the fields, a bride happened to paſs by with her train, who being obſerved by one Drochettus, a Frenchman, he ran to her, and began to uſe her in a rude manner, under pretence of ſearching for concealed arms. A young Sicilian, exaſperated at this affront, ſtabbed him with his own ſword; and a tumult enſuing, 200 French were immediately murdered. The enraged populace then ran to the city, crying out, "Let the French die, Let the French die;" and, without diſtinction of age or ſex, ſlaughtered all of that nation they could find, even ſuch as had fled to the churches. The conſpirators then left Palermo, and excited the inhabitants to murder the French all over the iſland, excepting in Meſſina, which city at firſt refuſed to be concerned in the revolt. But, being invited by the Palermitans to throw off the French yoke, a few weeks after, the citizens in a tumultuous manner deſtroyed ſome of the French; and pulling down the arms of king Charles, and erecting thoſe of the city, choſe one Baldwin for their governor, who ſaved the remaining French from the fury of the populace, and allowed them to tranſport themſelves, with their wives and children, to Italy. Eight thouſand perſons are ſaid to have been murdered on this occaſion.

27 They are maſſacred.

Immediately after this maſſacre, the Sicilians offered their allegiance to the king of Arragon; who accepted of the invitation, and landed with his forces at Trapani. From thence he went to Palermo, where he was crowned king of Sicily with great ſolemnity, and Charles left the iſland with precipitation. The day after he landed his army in Italy, the Arragonian fleet arrived, took 29 of his galleys, and the next day burnt 80 tranſports in preſence of his army. Soon after this Charles ſent an embaſſy to Peter, accuſing him of perfidy, in invading his dominions in time of peace; and, according to ſome, challenged him at the ſame time to decide the matter by ſingle combat. Others ſay, that the challenge was given by Peter. Certain it is, however, that a challenge was given, and to appearance accepted: but Peter determined to employ much more effectual means in ſupport of his pretenſions than truſting to a duel; and therefore puſhed on his operations moſt vigorouſly, while his adverſary trifled away his time: and thus he at laſt became maſter of the conteſted kingdom; which, however, he did not long enjoy, dying about the end of the year 1285.

By his will, Peter left the kingdom of Arragon to his eldeſt ſon Alphonſus, and Sicily to Don James his other ſon, who was alſo to ſucceed to the kingdom of Arragon in caſe Alphonſus ſhould die without male iſſue. Accordingly, Don James was ſolemnly crowned at Palermo the 2d of February 1286. In 1295, however, he deſerted them, and tamely reſigned up his right to Charles, ſon to him above-mentioned, in a manner perhaps unparalleled. On his reſignation the Sicilians conferred the crown upon his brother Don Frederic: after which the war continued with great violence till the year 1303, when a peace was concluded, and the kingdoms of Naples and Sicily formally disjoined; Frederic being allowed to keep the latter, under the name of *Trinacria;* and Charles being confirmed in the poſſeſſion of the former, which he quietly enjoyed till his death in 1309.

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28 The kingdoms of Naples and Sicily diſjoined.

Naples continued to be governed by its own kings till the beginning of the 16th century, when the kings of France and Spain contended for the ſovereignty of this country. Frederic, at that time king of Naples, reſigned the ſovereignty to Louis XII. on being created duke of Anjou, and receiving an annual penſion of 30,000 ducats. But, in 1504, the French were entirely defeated by the Spaniards, and obliged to evacuate the kingdom; and the following year Louis renounced all pretenſions to the crown, which from that time hath remained almoſt conſtantly in the hands of the Spaniards.

29 The Spaniards become maſters of Naples.

The government of the Spaniards proved no leſs oppreſſive to the Neapolitans than that of others had been. The kings of Spain ſet no bounds to their exactions, and of conſequence the people were loaded with all manner of taxes; even the moſt indiſpenſable neceſſaries of life not being exempted. In 1647, a new tax was laid on fruit; which the people looked upon as the moſt grievous oppreſſion, the chief part of their ſubſiſtence, during the ſummer months, being fruit, which in the kingdom of Naples is very plentiful and delicious. The edict for collecting the new duty was no ſooner publiſhed, than the people began to murmur in a tumultuous manner; and when the viceroy came abroad, they ſurrounded his coach, bawling out to have their grievances redreſſed. They were encouraged in their ſedition, by the news that the citizens of Palermo had actually revolted on account of the impoſition of new duties. The viceroy, therefore, apprehenſive of greater diſorders, began to think of taking off the tax; but thoſe who farmed the tax having bribed ſome of his favourites, he was by their means perſuaded not to aboliſh it. The indignation of the people, who had ſuſpected his intention, was now greatly increaſed, eſpecially as they were privately excited by ſeveral malcontents. The farmers of the revenue, and all thoſe concerned in raiſing the taxes, had incurred the hatred and deteſtation of the people, particularly of Tommaſo Aniello, commonly called *Maſſaniello of Amalfi*, a fiſherman, whoſe wife, having been diſcovered in ſmuggling a ſmall quantity of meal, was impriſoned, and condemned to pay a fine of 100 ducats.

30 A general revolt.

31 Account of Maſſaniello.

Maſſaniello, a few years before, had come to Naples from Amalfi, where his father had been a fiſherman. At this time he was about 24 years of age, and the father of four children He was of a middling ſtature, and an agreeable aſpect; was diſtinguiſhed for his boldneſs, activity, and integrity: and had a great influence with his companions, by whom he was beloved and eſteemed. As he was obliged even to ſell his furniture to pay the heavy fine, he had conceived an implacable hatred againſt the farmers of the taxes, and was alſo moved with compaſſion for the miſerable ſtate of the city and kingdom. He therefore formed a deſign, with ſome of his companions, to raiſe a tumult in the market-place on the feſtival-day of the Carmelites, uſually celebrated about the middle of July, when be-

tween

Naples. tween 500 and 600 youths entertain the people by a mock-fight; one half of them in the character of Turks, defending a wooden caſtle, which is attacked and ſtormed by the other half in the character of Chriſtians. Maſſaniello being appointed captain of one of theſe parties, and one Pione, who was privy to his deſign, commanding the other, for ſeveral weeks before the feſtival they were very diligent in reviewing and training their followers, who were armed with ſticks and reeds; but a ſmall and unforeſeen accident tempted them to begin their enterpriſe without waiting for the feſtival.

On the 7th of July a diſpute happening in the market-place betwixt the tax-gatherers and ſome gardeners of Pozzuolo who had brought ſome figs into the city, whether the buyer or ſeller ſhould pay the duty; after the tumult had continued ſeveral hours, Maſſaniello, who was preſent with his company, excited the mob to pillage the office built in the market for receiving the duty, and to drive away the officers with ſtones. The elect of the people, who, by deciding againſt the gardeners, had increaſed the tumult, ran to the palace, and informed the viceroy, who moſt imprudently neglected all means of putting a ſtop to the commotion. Maſſaniello, in the mean time, being joined by great numbers of people, ordered his young troop to ſet fire to all the offices for the taxes through the city; which command being executed with diſpatch, he then conducted them directly to the palace, where the viceroy, inſtead of ordering his Spaniſh and German guards to diſperſe them, encouraged their inſolence by timidly granting their demands. As they ruſhed into the palace in a furious manner, he eſcaped by a private door, and endeavoured to ſave himſelf in *Caſtel del Ovo*; but being overtaken by the rioters in the ſtreets, he was trampled upon by them, and pulled by the hair and whiſkers. However, by throwing ſome handfuls of gold among them, he again eſcaped, and took ſanctuary in a convent of Minims, where, being joined by the archbiſhop of Naples, cardinal Filomarini, and ſeveral nobles, by their advice he ſigned a billet, by which he aboliſhed all taxes upon proviſions. As a means to quell the tumult, he likewiſe deſired the cardinal to offer Maſſaniello a penſion of 2400 crowns, who generouſly rejected the bribe; and declared, that if the viceroy would keep his word, he would find them obedient ſubjects.

It was now expected that the tumult would ceaſe; but Maſſaniello, upon his return to the market-place, being joined by ſeveral malcontents, among whom were Genuino and one Peronne, who had formerly been a captain of the Sbirri, he was adviſed by them to order the houſes of thoſe concerned in raiſing the tax to be burned; which were accordingly in a few days reduced to aſhes, with all their rich furniture. Maſſaniello being now abſolute maſter of the whole city, and being joined by great numbers of people of deſperate fortunes, he required the viceroy, who had retired to the *Caſtel Nuovo*, to aboliſh all the taxes, and to deliver up the writ of exemption granted by Charles V. This new demand greatly embarraſſed the viceroy; but to appeaſe the people, he drew up a falſe deed in letters of gold, and ſent it to them by their favourite the duke of Matalone, who had before been in confinement. The fraud, however, being diſcovered, the duke was pulled from his horſe and maltreated by the mob, and at length committed as a priſoner to Peronne. Naples. This accident, to the great joy of the viceroy, enraged the people againſt the nobility, ſeveral of whom they killed, burnt the houſes of others, and threatened to extirpate them all. Maſſaniello, in the mean time, tattered and half naked, commanded his followers, who were now well armed, and reckoned about 100,000 men, with a moſt abſolute ſway. He eat and ſlept little, gave his orders with great preciſion and judgement, appeared full of moderation, without ambition and intereſted views. But the duke of Matalone having procured his liberty by bribing Peronne, the viceroy imitated his example, and ſecretly corrupted Genuino to betray his chief. A conſpiracy was accordingly formed againſt Maſſaniello by Matalone and Peronne; the duke, who was equally exaſperated againſt the viceroy, propoſing, that after his death his brother D. Joſeph ſhould head the rebels.

Maſſaniello in the mean time, by means of the cardinal archbiſhop, was negociating a general peace and accommodation; but while both parties were aſſembling in the convent of the Carmelites, the banditti hired by Matalone made an unſucceſsful attempt upon Maſſaniello's life. His followers immediately killed 150 of them. Peronne and D. Joſeph being diſcovered to be concerned in the conſpiracy, were likewiſe put to death, and the duke with great difficulty eſcaped. Maſſaniello by this conſpiracy was rendered more ſuſpicious and ſevere. He began to abuſe his power by putting ſeveral perſons to death upon ſlight pretences; and, to force the viceroy to an accommodation, he cut off all communication with the caſtles, which were unprovided with proviſion and ammunition.—The viceroy likewiſe being afraid leſt the French ſhould take advantage of the commotion, earneſtly deſired to agree to a treaty; which was accordingly concluded on the fifth day of the inſurrection, by the mediation of the archbiſhop. By the treaty it was ſtipulated, that all duties impoſed ſince the time of Charles V. ſhould be aboliſhed; that the writ of exemption granted by that emperor ſhould be delivered to the people; that for the future no new taxes ſhould be impoſed; that the vote of the elect of the people ſhould be equal to the votes of the nobility; that an act of oblivion ſhould be granted for all that was paſt; and that the people ſhould continue in arms under Maſſaniello till the ratification of the treaty by the king.

32 A treaty concluded between Maſſaniello and the viceroy.

By this treaty, no leſs than 10,000 perſons, who fattened upon the blood of the public, were ruined.—The people, when it was ſolemnly publiſhed, manifeſted an extreme joy, believing they had now recovered all their ancient rights and privileges. Maſſaniello, at the deſire of the viceroy, went to the palace to viſit him, accompanied by the archbiſhop, who was obliged to threaten him with excommunication, before he would conſent to lay aſide his rags and aſſume a magnificent dreſs. He was received by the duke with the greateſt demonſtrations of reſpect and friendſhip, while the ducheſs entertained his wife, and preſented her with a robe of cloth of ſilver, and ſome jewels.—The viceroy, to preſerve ſome ſhadow of authority, appointed him captain-general; and at his departure made him a preſent of a golden chain of great value, which with great difficulty he was prevailed upon to accept;

33 Maſſaniello appointed captain-general.

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accept; but yielded at length to the intreaties of the cardinal. Next day, in conſequence of the commiſſion granted him by the viceroy, he began to exerciſe all the functions of ſovereign authority; and having cauſed a ſcaffold to be erected in one of the ſtreets, and ſeveral gibbets, he judged all crimes, whether civil or military, in the laſt reſort; and ordered the guilty to be immediately put to death, which was the puniſhment he aſſigned to all offences. Though he neglected all forms of law, and even frequently judged by phyſiognomy, yet he is ſaid not to have overlooked any criminal, or puniſhed any innocent perſon.

His grandeur and proſperity was of very ſhort continuance; for his mind becoming diſtracted and delirious for two or three days, he committed a great many mad and extravagant actions; and on the 18th of July was aſſaſſinated with the conſent of the viceroy.

34 Is aſſaſſinated.

The tumult did not end with the death of Maſſaniello: on the contrary, the people now expelled the Spaniards from moſt of the cities throughout the kingdom; and this general inſurrection being the ſubject of diſcourſe at Rome, the duke of Guiſe, who happened then to be at the pope's court, took the opportunity, at the inſtigation of his holineſs, to offer his ſervice to the Neapolitans againſt the Spaniards. The duke was prompted by his ambition to engage in this enterpriſe, eſpecially as he himſelf had ſome diſtant pretenſions to the crown. The Spaniards in the mean time made a vigorous attack on the city; but were repulſed by the people, who now formally renounced their allegiance to them. In a ſhort time, however, their city being ſurpriſed by the new viceroy, the count d'Oniate, and the duke of Guiſe himſelf taken priſoner, the people returned to their allegiance; and thus all the attempts of the French on Naples were fruſtrated. Since that time the Spaniards continued in peaceable poſſeſſion of the kingdom till the year 1707, when it was taken from them by prince Eugene. It was formally ceded to the emperor by the treaty of Raſtadt in 1713; but was recovered by the Spaniards in 1734, and the king of Spain's eldeſt ſon is now king of Naples and Sicily. For a particular account of theſe revolutions, ſee the articles SPAIN and SICILY.

35 The people return to their allegiance.

36 Climate, produce, &c. of Naples.

The climate of Naples is extremely hot, eſpecially in July, Auguſt, and September. In winter there is ſeldom any ice or ſnow, except on the mountains.—On account of its fertility, it is juſtly termed an earthly paradiſe; for it abounds with all ſorts of grain, the fineſt fruit and garden-productions of every kind, with rice, flax, oil, and wine, in the greateſt plenty and perfection. It affords alſo ſaffron, manna, alum, vitriol, ſulphur, rock-cryſtal, marble, and ſeveral ſorts of minerals, together with fine wool, and ſilk. The horſes of this country are famous, and the flocks and herds very numerous. Beſides theſe products, of which a conſiderable part is exported, there are manufactures of ſnuff, ſoap, and glaſs-ware. Waiſtcoats, caps, ſtockings, and gloves, are alſo made of the hair or filaments of a ſhell-fiſh, which are warmer than thoſe of wool, and of a beautiful gloſſy green. In this kingdom likewiſe is found that called the *Phrygian ſtone*, or *pietra fungifera*, which, being laid in a damp ſhady place, will yield muſhrooms, ſometimes of a very large ſize, eſpecially if the ſtone is ſprinkled with hot water. See AGARICUS.

As to the mountains of this country, the principal are thoſe of the Apennine, which traverſe it from ſouth to north; and Mount Veſuvius, which, as is well known, is a noted volcano, five Italian miles from Naples. The ſide of this mountain next the ſea yields wine, particularly the two famed wines called *Vino Greco* and *Lachrymæ Chriſti*. One of the greateſt inconveniencies to which this kingdom is expoſed is earthquakes, which the eruptions of Mount Veſuvius contribute, in ſome meaſure, to prevent. Another inconveniency, which, however, is common to it with other hot countries, is the great number of reptiles and inſects, of which ſome are very poiſonous.

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37 Religion.

With reſpect to religion, it is on a very bad footing here. The number of convents and monaſteries is aſtoniſhing. It is ſaid, the clergy and convents poſſeſs two thirds of the whole kingdom: nay, ſome maintain, that were the kingdom divided into five parts, four would be found in the hands of the church. Notwithſtanding this power and influence of the clergy, they have not been able hitherto to get the inquiſition eſtabliſhed here. In the year 1731, meaſures were taken for leſſening the number of convents; and lately the order of Jeſuits hath been ſuppreſſed. The papal bulls cannot be made public without the king's permiſſion; nor are Proteſtants compelled to kneel in the churches, or at meeting the hoſt; and in Lent they can very eaſily procure fleſh meat. In the year 1740, the Jews were allowed to ſettle in the kingdom during the term of 50 years, and ſeveral privileges were granted them during that period; at the expiration of which, the grant was ſuppoſed to be renewed, unleſs they were expreſsly ordered to quit the country.

38 Revenue, &c.

The revenue of the kingdom is generally computed at 3,000,000 of crowns: but, as Mr Addiſon obſerves, there is no country in Europe which pays greater taxes, and where, at the ſame time, the public is leſs the better for them, moſt of them going to the enriching of the private perſons to whom they are mortgaged.

The military force of this kingdom is ſaid to conſiſt of about 30,000 men, of which the Swiſs regiments are the beſt. As to the marine, it conſiſts only of a few galleys. The only order here is that of St Januarius, which was inſtituted by Don Carlos in the year 1738.

The king of Naples, or of the two Sicilies, is an hereditary monarch. The high colleges are the council of ſtate, the privy-council, the treaſury, the Sicily-council, the council of war, &c. This kingdom is a papal fief; and the king, in acknowledgment of the pope's feudal right, ſends him every year a white palfry, and a purſe of 6000 ducats. The title of the king's eldeſt ſon is *prince of Calabria*. The number both of the high and low nobility in the kingdom of Naples is very great. "I am aſſured (ſays Dr Moore§) that the king of Naples counts among his ſubjects 100 perſons with the title of prince, and a ſtill greater with that of duke. Six or ſeven of theſe have eſtates which produce from 10 to 12 or 13,000 l. a year; a conſiderable number have fortunes of about half the value; and the annual revenue of many is not above 1000 l. or 2000 l. The inferior orders of the nobility are much poorer. Many counts and marquiſſes have not above 300 l. or 400 l. a year of paternal eſtate; many have ſtill leſs; and not a few enjoy the title without any eſtate whatever. Theſe nobles, however, are exceſſively

§ *View of Society, &c. in Italy.*

Naples. exceſſively fond of ſplendor and ſhow, which appears in the brilliancy of their equipages, the number of their attendants, the richneſs of their dreſs, and the grandeur of their titles. The fineſt carriages are painted, gilt, varniſhed, and lined, in a richer and more beautiful manner than has yet become faſhionable either in England or in France. They are often drawn by ſix and ſometimes by eight horſes. Before the carriage, it is the mode to have two running footmen, and behind three or four ſervants in the richeſt liveries. The ladies and gentlemen within the coaches glitter in all the brilliancy of lace, embroidery, and jewels.—This finery is not confined to the perſons within and without the coaches; it is extended to the horſes, whoſe heads, manes, and tails, are ornamented with the rareſt plumage, and ſet off with ribbon and artificial flowers."

We ſhall mention a circumſtance from which an idea may be formed of the grandeur of a Neapolitan palace, and the number of domeſtics which ſome of the nobility retain. "I dined (continues our author) at the prince Iacci's, where we paſſed through 12 or 13 large rooms before we arrived at the dining-room. There were 36 perſons at table ſerved by the prince's domeſtics, and each gueſt had a footman behind his chair, while other domeſtics belonging to the prince remained in the adjacent rooms and in the hall. No eſtate in England could ſupport ſuch a number of ſervants, paid and fed as Engliſh ſervants are; but in Naples the wages are very moderate indeed, and the greater number of men-ſervants, belonging to the firſt families, give their attendance through the day only, and find beds and proviſions for themſelves. It muſt be remembered alſo, that few of the nobles give any entertainments; and thoſe who do not are ſaid to live very ſparingly; ſo that the whole of their revenue, whatever it may be, is expended on articles of ſhow."

In the kingdom of Naples, the hereditary juriſdiction of the nobles over their vaſſals ſubſiſts in the full rigour of the feudal government. The peaſants therefore are poor; and it depends entirely on the perſonal character of the maſter, whether their poverty be not the leaſt of their grievances. As this power is too often abuſed, the importance of the nobility depends in a great meaſure on the favour of the king, who, under pretence of any offence, can confine them to their eſtates, or impriſon them at pleaſure. Unleſs this prince were ſo very impolitic as to diſguſt all the nobility at once, and ſo unite the whole body againſt him, he has little to fear from their reſentment. Even in caſe of ſuch an union, as the nobles have loſt the affection of their vaſſals, what could they do in oppoſition to a ſtanding army of 30,000 men, entirely devoted to the crown? The government of Naples, therefore, is in fact a deſpotic monarchy, though ſomething like the form of a feudal conſtitution in its ancient purity is ſtill kept up by the biennial ſummons of the general aſſembly. This convention, which conſiſts of the nobility and commons, is called together every two years, to deliberate on the cuſtomary free-gift to the crown.

The inhabitants of this country have at all times borne but an indifferent character among other nations. "From the few hints dropped by the claſſic authors, we collect that the ancient Neapolitans were a race of Epicureans, of a ſoft indolent turn, averſe from martial exerciſes, paſſionately fond of theatrical amuſements and muſic, expert in all the refined arts that adminiſter to the caprices of luxury, extravagant in their expreſſions and geſtures, and dupes to various ſorts of ſuperſtition. If we make allowance for a quantity of northern blood which has joined the original Grecian ſtream, and imparted a roughneſs not yet worn off by the mildneſs of the climate, we ſhall find the modern Neapolitans very like the ancient.—Proviſions being here plentiful and cheap, the lower claſs of people work but little. Their delight is to baſk in the ſun, and do nothing. Perſons of a middle rank frequent places of public reſort; and very few of any rank attend to their proper buſineſs with the zeal and activity we are wont to meet with in the profeſſional men of colder countries. Gluttony is a predominant vice, while inſtances of ebriety are comparatively rare. In the female ſex, the paſſion for finery is almoſt ſuperior to every other; and, though chaſtity is not the characteriſtic virtue of the country, Mr Swinburne doubts § whether a Neapolitan woman would not nine times out of ten prefer a preſent to a lover. That furious jealouſy for which the nation was once ſo remarkable, is now greatly abated. The breach of the conjugal vow ſometimes occaſions quarrels and aſſaſſinations among people of an inferior ſtation; and in the metropolis, aſſaſſinations are often perpetrated from much leſs cogent motives. Of theſe vices, many are doubtleſs owing to that ſlavery and oppreſſion under which they groan, and to a radical defect in the adminiſtration of juſtice, though the kingdom is divided into 12 provinces or juriſdictions.

§ *Travels in the Two Sicilies.*

Naples.

Naples, anciently *Parthenope*, afterwards *Neapolis*, the capital of the kingdom of that name in Italy, lies in the province called *Terra di Lavora*, which is the richeſt and beſt inhabited of the whole kingdom, and comprehends a part of the ancient Campania Felix, or the Happy. This city is fabled to owe its foundation to a ſyren, and to have received its ancient name from its ſupernatural foundreſs. Whatever be its origin, it is the firſt for neatneſs, and the ſecond for extent, of all the cities in Italy. It was formerly a place of ſtrength; but its walls at preſent being of no real defence, its ſafety depends of courſe upon the force of its armies. It is moſt advantageouſly ſituated, having a delicious country on one ſide, and a noble bay of the Mediterranean on the other, with an excellent harbour. The circumference, including the ſuburbs, is ſaid not to be leſs than 18 Italian miles, and the number of the inhabitants therein little leſs than 400,000. The houſes are of ſtone, flat-roofed, and generally lofty and uniform; but many of them have balconies, with lattice-windows. The ſtreets are well paved; but they are not lighted at night, and in the day-time are diſfigured, in many places, by ſtalls, on which proviſions are expoſed to ſale. Here are a great number of fine churches, convents, fountains, and palaces of the nobility, many of whom conſtantly reſide here. It is uſual to walk on the tops of the houſes in the evenings, to breathe the ſweet cool air, after a hot ſultry day. The climate here is ſo mild and warm, even in the winter, that plenty of green peaſe, artichokes, aſparagus, and other vegetables,

Naples. may be had ſo early as the beginning of the new year, and even all the winter. This city ſwarms with monks and nuns of all ſorts, to ſuch a degree, that there are no leſs than 19 convents of the Dominicans alone, 18 of the Franciſcans, 8 of the Auguſtines, and an equal proportion of the reſt. The magnificence of many of the churches exceeds imagination. In a cloyſter of the Carthuſian monaſtery is a crucifix, ſaid to be done by Michael Angelo, of inimitable workmanſhip.

To repel hoſtile attempts by ſea, which, from its ſituation, maritime powers might be tempted to make, Naples has, to the weſt, the Caſtel del Uovo, a confuſed pile of ancient buildings, and ſome modern batteries. The rock upon which this fortreſs ſtands was originally called *Megara*, then *Lucullanum*, and was conſidered as a place of ſtrength ſo early as in the year 475. Along the line of the ſhore towards the eaſt are ſome batteries on the points of land, the baſtions of the arſenal, and above it the lofty wall of the Caſtel Nuovo. This laſt fortreſs has been the uſual refuge of the ſovereigns and viceroys in all civil wars and tumults; for which reaſon they have long fixed their reſidence near its walls. A block-houſe and batteries defend the mouth of the harbour, and at the eaſtern extremity of the town is the Torrione de Carmine, better known by the figure it made in Maſſaniello's rebellion than by its extent or military ſtrength. The caſtle of Saint Elmo commands Naples in every direction, and is in reality calculated rather to annoy and awe the citizens than to defend them from foreign invaders. The city is indeed far from being ſecure againſt a bombardment; for the ſea is ſo deep, that a large veſſel may come up to the very mole in defiance of the block-houſe and batteries, &c. Pictures, ſtatues, and antiquities, are not ſo common in Naples as might be expected in ſo great and ancient a city, many of the moſt valuable pieces having been ſent to Spain by the viceroys. The bay is one of the fineſt in the world, being almoſt of a round figure, of about 30 miles in diameter, and three parts of it ſheltered with a noble circuit of woods and mountains. The city ſtands in the boſom of this bay, in as pleaſant a ſituation, perhaps, as in the world. Mr Keyſler ſays, they reckon about 18,000 *donne libere*, or courtezans in the city, and Dr Moore computes the number of *lazzarani* or blackguards at above 30,000. The greater part of theſe wretches have no dwelling-houſes, but ſleep every night under porticos, piazzas, or any kind of ſhelter they can find. Thoſe of them who have wives and children, live in the ſuburbs of Naples near Peuſilippo, in huts, or in caverns or chambers dug out of that mountain. They are generally repreſented as a lazy, licentious, and turbulent ſet of people, as indeed by far the greater of the rabble are, who prefer begging or robbing, or running errands, to any fixed and permanent employmrnt. Yet there are in Naples ſome flouriſhing manufactures, particularly of ſilk ſtockings, ſoap, ſnuff-boxes of tortoiſe ſhells and the lava of Mount Veſuvius, tables, and ornamental furniture of marble. The city is ſupplied with a vaſt quantity of water, by means of a very coſtly aqueduct, from the foot of Mount Veſuvius. Mr Addiſon ſays, it is incredible how great a multitude of retainers to the law there are in Naples, who find continual employment from the fiery temper of the inhabitants. There are five piazzas or ſquares in the city, appropriated to the nobility, viz. thoſe called *Capuana*, *Nido*, *Montagna*, *Porto*, and *Porta Nova*. Of all the palaces, that of the king is not only the moſt magnificent, but alſo in the beſt ſtyle of architecture. The cathedral, though Gothic, is a very grand ſplendid edifice. It is here that the head and blood of St Januarius, the tutelary ſaint of Naples, are kept, the latter in two glaſs or cryſtal vials. The pretended liquefaction of the dried blood, as ſoon as brought near the head of the ſaint, is a thing well known; Mr Addiſon ſays, it is one of the moſt bungling tricks he ever ſaw†. The harbour is ſpacious, and kept in good repair. It is fortified with a mole, which runs above a quarter of a mile into the ſea, and at the extremity has a high lantern to direct ſhips ſafely into the harbour. Luxury here is reſtrained by ſevere ſumptuary laws, and the women are more cloſely confined than in any other city of Italy. Here is an univerſity and two academies of wits, the one called *Gli Ardenti*, and theother *Gli Otioſi*. The nunnery for ladies of quality is ſaid to be the largeſt in the whole world, containing no leſs than 350 nuns, beſides ſervants. The Mount of Piety, or the office for advancing money to the poor, on pledges, at a low intereſt, or without any, has an income of upwards of 50,000 ducats. The arſenal is ſaid to contain arms for 50,000 men. The walls of the city conſiſt of hard black quarry ſtones, called *piperno*.—Inſtead of ice, vaſt quantities of ſnow are uſed for cooling their liquors, not ſo much as water being drank without it; ſo that, it is ſaid, a ſcarcity of it would as ſoon occaſion a mutiny as a dearth of corn or proviſions. Certain perſons, who farm the monopoly of it from the government, ſupply the city all the year round from a mountain about 18 miles off, at ſo much the pound. Naples ſtands 110 miles ſouth-eaſt from Rome, 164 north-eaſt from Palermo in Sicily, 217 ſouth-eaſt from Florence, and 300 from Venice. E. Long 14. 20. N. Lat. 40. 55.

† See *Chemiſtry*, n° 800.

NARBO (anc. geog.), a town of the Volcæ Tectoſages, called alſo *Narbo Martius*, from the Legio Martia, the colony led thither 59 years before the conſulate of Cæſar, (Velleius); increaſed with a colony of the Decumani or tenth legion by Cæſar. An ancient trading town on the Atax, which diſcharges itſelf into the ſea through the Lacus Rubreſus, or Rubrenſis. Capital of the Gallia Narbonenſis; ſurnamed *Colonia Julia Paterna*, from Julius Cæſar, the father of Auguſtus by adoption. Now called *Narbonne*, a city of Languedoc.

Naples || Narbonne.

NARBONNE, is a city of France in Lower Languedoc, with an archbiſhop's ſee, and is particularly famous for its honey. It is ſeated on a canal cut from the river Aude, which being but three miles from the ſea, veſſels come up it laden with merchandiſe, which renders it a place of ſome trade. But though it pretends to the moſt remote antiquity under the Celtic kings, in ages anterior even to the Roman conqueſts, which under theſe latter maſters gave its name to all the *Gallia Narbonenſis*, and was a colony of the firſt conſideration, it is now dwindled to a wretched ſolitary town, containing ſcarce 8000 inhabitants, of whom three fourths are prieſts and women. The ſtreets and buildings are mean and ruinous; it has indeed a commu-

Narciſſus. nication with the Mediterranean, from which Narbonne is only about three leagues diſtant, by means of a ſmall river which interſects the place; but their commerce is very limited, and chiefly conſiſts in grain which they export to Cette and Marſeilles. No marks of Roman magnificence remain, except ſeveral inſcriptions in different parts of the city. It is divided into the city and the town, which are joined together by a bridge, with houſes on each ſide, in which the richeſt merchants live. There are ſeveral churches and convents, and the metropolitan church has a handſome ſteeple. E. Long. 2. 6. N. Lat. 43. 11.

NARCISSUS, in fabulous hiſtory, the ſon of the river Cephiſſus and Liriope the daughter of Oceanus, was a youth of great beauty. Tireſias foretold that he ſhould live till he ſaw himſelf. He deſpiſed all the nymphs of the country; and made Echo languiſh till ſhe became a mere ſound, by refuſing to return her paſſion: but one day coming weary and fatigued from the chace, he ſtopped on the bank of a fountain to quench his thirſt; when, ſeeing his own form in the water, he became ſo in love with the ſhadowy image, that he languiſhed till he died. On which the gods, being moved at his death, changed him into the flower which bears his name.

Narcissus, in botany: A genus of the monogynia order, belonging to the hexandria claſs of plants; and in the natural method ranking under the 9th order, *Spathaceæ*. There are ſix petals; the nectarium is funnel-ſhaped, and monophyllous; the ſtamina are within the nectarium. The moſt remarkable ſpecies are,

1. The baſtard narciſſus, or common yellow Engliſh daffodil, grows wild in great plenty in many of our woods and coppices, and under hedges in ſeveral parts of England. In the counties round London the herbfolks bring prodigious quantities in the ſpring of the year, when in bloom, root and all, and ſell them about the ſtreets. Its commonneſs renders it of but little eſteem with many; conſidered, however, as an early and elegant flower, of exceeding hardineſs and eaſy culture, it merits a place in every garden.

2. The bicolor, or two-coloured incomparable narciſſus, hath a large, oblong, bulbous root; crowned with long, narrow, dark-green leaves, 12 or 14 inches long; an upright flower-ſtalk, about 15 inches high, terminated by an uniflorous ſpatha, protruding one large flower with white petals, and a bell-ſhaped, ſpreading, golden nectarium, waved on the margin, and equal in length with the corolla; flowering in April. The varieties are, common ſingle-flowered—ſemi-double-flowered, with the interior petals ſome white and ſome yellow—with ſulphur-coloured flowers.

3. The poeticus, poetic daffodil, or common white narciſſus, is well known. Of this there are varieties with purple-cupped flowers—yellow-cupped flowers—double-flowered: all of them with entire white petals. It is the ancient celebrated narciſſus of the Greek and Roman poets, which they ſo greatly extol for its extreme beauty and fragrance.

4. The bulbocodium, hath a ſmall bulbous root, crowned with ſeveral narrow, ſubulate, ruſh-like leaves, ſix or eight inches long; amidſt them a ſlender, taper flower-ſtalk, ſix inches high, terminated by an uniflorous ſpatha, protruding one yellow flower, having the nectarium much larger than the petals, and very broad and ſpreading at the brim; flowering in April. From the large ſpreading nectarium of this ſpecies, which being three or four times longer than the petals, narrow at bottom, and widening gradually to the brim, ſo as to reſemble the ſhape of ſome old-faſhioned hoop-petticoats, it obtained the name *hoop-petticoat narciſſus*. Narciſſus.

5. The ſerotinus, or late-flowering ſmall autumnal narciſſus, hath a ſmall bulbous root; crowned with a few narrow leaves; amidſt them a jointed flower-ſtalk, eight or nine inches high, terminated by an uniflorous ſpatha, protruding one white flower, having a ſhort, ſix-parted, yellow nectarium; flowering in autumn.

6. The tazetta, or multiflorous daffodil, commonly called *polyanthus narciſſus*, hath a very large, roundiſh, bulbous root; long, narrow, plane leaves; an upright flower-ſtalk, riſing from 10 or 12 inches to a foot and a half high; terminated by a multiflorous ſpatha, protruding many large, ſpreading, white and yellow flowers, in a cluſter, having bell-ſhaped nectariums ſhorter than the corolla; flowering in February, March, and April, and is very fragrant. The varieties of this are very numerous, conſiſting of about eight or nine principal ſorts, each of which having many intermediate varieties; amounting in the whole greatly above an hundred in the Dutch floriſts catalogues, each variety diſtinguiſhed by a name according to the fancy of the firſt raiſer of it. They are all very pretty flowers, and make a charming appearance in the flower-borders, &c. they are alſo finely adapted for blowing in glaſſes of water, or in pots, to ornament rooms in winter.

7. The jonquilla, or jonquil, ſometimes called *ruſh-leaved daffodil*, hath an oblong, bulbous, brown root; ſending up ſeveral long, ſemi-taper, ruſh-like, bright-green leaves; amidſt them an upright green flower-ſtalk, a foot or 15 inches high; terminated by a multiflorous ſpatha, protruding many yellow flowers, often expanded like a radius, each having a hemiſpherical, crenated nectarium, ſhorter than the petals; flowering in April, and moſtly of a fine fragrance. The varieties are, jonquil minor with ſingle flowers—jonquil major with ſingle flowers—ſtarry flowered—yellow and white flowered—white-flowered—ſemi-double-flowered—double-flowered—and large double inodorous jonquil: all of them multiflorous, the ſingle in particular; but ſometimes the doubles produce only two or three flowers from a ſpatha, and the ſingles commonly ſix or eight. All the ſorts have ſo fine a ſhape, ſo ſoft a colour, and ſo ſweet a ſcent, that they are ſome of the moſt agreeable ſpring-flowers.

8. The calathinus, or multiflorous yellow narciſſus, hath a large bulbous root; crowned with long, narrow, plane leaves; and amidſt them an erect, robuſt flower-ſtalk, terminated by a multiflorous ſpatha, protruding many large, entire, yellow flowers, having a bell-ſhaped, ſlightly crenated nectarium, equal in length with the petals.

9. The odorus, odoriferous, or ſweet-ſcented ſtarry yellow narciſſus, hath a bulbous root; narrow leaves; erect flower-ſtalk, a foot or more high, terminated by a ſub-multiflorous ſpatha, protruding ſometimes but

Narciſſus || Nardo.

one, and ſometimes ſeveral entirely yellow flowers, having a campanulated, ſix-parted, ſmooth nectarium, half the length of the petals.

10. The triandrus, or triandrous ruſh-leaved white narciſſus, hath a bulbous root; very narrow, ruſh-like leaves; erect flower-ſtalk, terminated by an uniflorous ſpatha, protruding one ſnowy-white flower, having a bell-ſhaped, crenated nectarium, half the length of the petals, and with moſtly triandrous or three ſtamina.

11. The trilobus, or trilobate yellow narciſſus, hath a bulbous root; narrow ruſh-like leaves; erect flower-ſtalks, terminated by a ſub-multiflorous ſpatha, protruding ſometimes but one or two, and ſometimes ſeveral, yellow flowers, having a bell-ſhaped, three-lobed nectarium, half the length of the petals.

12. The minor, or yellow winter daffodil, hath a ſmall bulbous root; plane leaves, eight or ten inches long, and more than half a one broad; an erect flower-ſtalk, terminated by an uniflorous ſpatha, protruding one nodding yellow flower, with ſpear-ſhaped petals, having an obconic, ſix-parted, waved nectarium, equal to the length of the corolla; flowering in winter, or very early in ſpring.

All theſe 12 ſpecies of narciſſus are of the bulbous-rooted tribe, and univerſally perennial in root, but annual in leaf and flower-ſtalk; all of them riſing annually in ſpring, immediately from the crown of the bulb, firſt the leaves, and in the midſt of them the flower-ſtalk, one only from each root, entirely naked or leafleſs, each terminated by a ſpatha or ſheath, which opens on one ſide to protrude the flowers, and then withers; the flowers, as before obſerved, are all hexapetalous, each furniſhed with a nectarium in the centre, and are univerſally hermaphrodite: they are large and conſpicuous, appearing moſtly in the ſpring-ſeaſon, generally from March or April until June, ſucceeded by ripe ſeed in July; then the leaves and flower-ſtalks decay, and the roots deſiſt from growing for ſome time; at which period of reſt is the only proper time to take up or tranſplant the roots from one place to another, or to ſeparate the offsets; for they all multiply abundantly by offset young bulbs from the main root, inſomuch that a ſingle bulb will in one or two years be increaſed into a large cluſter of ſeveral bulbs, cloſely placed together, and which every ſecond or third year ſhould be taken up at the above period in order to be ſeparated; and each offset ſo ſeparated commences a diſtinct plant; which being planted again in autumn, produces flowers the following ſummer, alike in every reſpect to thoſe of their reſpective parent bulbs. All the ſpecies are ſo hardy that they proſper in any common ſoil of a garden; obſerving, however, to allow the finer ſorts of *polyanthus narciſſus*, in particular, principally a warm dry ſituation; all the others may be planted any where in the open dry borders and flower-beds.

NARCOTICS, in medicine, ſoporiferous drugs, which bring on a ſtupefaction. Among narcotics the moſt eminent are thoſe uſually prepared for medicinal uſes from the poppy, eſpecially opium; as alſo all thoſe prepared from mandragoras, hyoſcyamus, ſtramonium, and datura.

NARDO, a pretty populous town in the kingdom of Naples, and in the Terra d'Otranto, with the title of a duchy and a biſhop's ſee. E. Long. 18. 27. N. Lat. 43. 28. Nardus.

In this little city are 8000 inhabitants. The ſteeple of its cathedral is built in a very uncommon but ſhowy ſtyle of Gothic architecture. Luca Giordano and Solimeni have adorned the church with ſome agreeable paintings. This place was part of the Balzo eſtate. The Aquavivas were the next poſſeſſors: they are thought to have come from the Marca di Ancona. In 1401, in conſideration of their relationſhip to Pope Boniface IX. Laudiſlaus erected their manor of Atri into a dukedom, an honour till then ſeldom granted to any but princes of the blood royal. Claudius Aquaviva, a famous general of the Jeſuits, who died in 1615, was of this family.

NARDUS, in botany: A genus of the monogynia order, belonging to the triandria claſs of plants; and in the natural method ranking under the 4th order, *Gramina*. There is no calyx; the corolla is bivalved.

This plant was highly valued by the ancients, both as an article of luxury and medicine. The *unguentum nardinum* was uſed at baths and feaſts as a favourite perfume. Its value is evident from that paſſage of ſcripture, where our Saviour's head was anointed with a box of it, with which Judas found fault. From a paſſage in Horace it appears that this ointment was ſo valuable among the Romans, that as much as could be contained in a ſmall box of precious ſtone was conſidered as a ſort of equivalent for a large veſſel of wine, and a proper quota for a gueſt to contribute at an entertainment, according to the ancient cuſtom:

——— *Nardo vina merebere,*
Nardi parvus onyx eliciet cadum.

The plant had a great character among the ancients as a medicine, both internally taken and externally applied. It has a place in the liſt of all antidotes from thoſe of Hippocrates (given on the authority of Myrepſus and Nicholaus Alexandrinus) to the officinals which have kept their ground till lately, under the names of *Mithridate* and *Venice treacle*. Galen and Alexander Trallian recommend it in the dropſy and gravel; Celſus and Galen in pains of the ſtomach and bowels, both internally given and externally applied. Galen preſcribed the oleum nardinum to the emperor Marcus Aurelius when afflicted with a cholera morbus. It was externally applied to the ſtomach on wool; and the ſucceſs was ſo great, that he ever afterwards enjoyed the higheſt confidence of that emperor. In a work attributed to Galen, alſo, it is mentioned that a medicine compoſed of this and ſome other aromatics was found uſeful in long protracted fevers; and the natives of India at preſent conſider it as a very efficacious remedy in fevers. Its ſenſible qualities, indeed, promiſe it to be of conſiderable efficacy in ſome caſes, as it has a pungency of taſte ſuperior to contrayerva, and little inferior to ſerpentaria.

But though the name of this plant, with the uſes and virtues of it, has long been familiar in the writings of botaniſts and phyſicians, the genus and ſpecies of the plant have only been aſcertained very lately. In the Philoſphical Tranſactions for 1790, Dr Blane gives an account of it from a letter ſent him by his brother from Lucknow, dated in December 1786.—According to this gentleman's relation, being one day

on

Nardus. on a hunting party with the nabob viſier, after croſsing the river Rapty, about 20 miles from the foot of the northern mountains, he was ſurpriſed to find the air perfumed with an aromatic ſmell, which, as he was told, proceeded from the roots of the graſs that were bruiſed or torn out of the ground by the nabob's elephants and horſes. The country was wild, uncultivated, and entirely covered with this kind of graſs, which grew in large tufts cloſe to each other, and from three to four feet long. As none of it was in flower, it being then the winter ſeaſon, and the graſs having beſides been burnt down by order of the nabob, our author cauſed ſome of the roots to be dug up, in order to plant it in his garden at Lucknow.—Here it proſpered exceedingly; and ſhot up ſpikes to the height of ſix feet. A ſpecimen was ſent to Sir Joſeph Banks, who found it to belong to the genus of andropogon, different from any ſpecies hitherto deſcribed by botaniſts. "There is great reaſon, however (ſays Dr Blane), to think that it is the true nardus Indica of the ancients; for, 1. The circumſtance of its diſcovery correſponds in a ſtriking manner with an occurrence related by Arrian in his Hiſtory of Alexander's Expedition into India. During the march of that hero through the deſarts of Gedroſia, the air was perfumed by the ſpikenard, which was trampled under foot by the army; and the Phœnicians, who accompanied them, collected great quantities of it, as well as of myrrh, to carry them into their own country to make merchandiſe of them. This laſt circumſtance ſeems further to aſcertain it to have been the true nardus; for the Phœnicians, who even in war appear to have retained their true genius for commerce, could no doubt diſtinguiſh the proper quality of this commodity. I am informed by major Rennel, that Gedroſia anſwers to the modern Mackran, or Kedgemackran, a maritime province of Perſia, ſituated between Kermon (the ancient Carmania), and the river Indus, being of courſe the frontier province of Perſia towards India; and that it appears from Arrian's account, and from a Turkiſh map of Perſia, that this deſart lies in the middle tract of country between the river Indus and the Perſian gulf, and within a few days march of the Arabian or Erythræan ſea. By this the ancients meant the northern part of the Ethiopic ocean, which waſhes the ſouthern coaſts of Arabia and Perſia; not what we now call the Red Sea, as its name would ſeem to imply, for this by the ancients was called the *Arabian Gulf*. 2. Though the accounts of the ancients concerning this plant are very defective, it is plain that it was of the natural order of gramina; for the term *ariſta*, ſo often applied to it, was appropriated by them to the fructification of grains and graſſes, and ſeems to be a word of Greek original, to denote the moſt excellent portion of thoſe plants, which are the moſt uſeful in the vegetable creation for the ſuſtenance of animal life; and nature has alſo kindly made them the moſt abundant in all parts of the habitable earth. Galen ſays, that though there are various ſorts of nardus, the term νάρδος σάκχος, or *ſpikenard*, ſhould not be applied to any but the nardus Indica. It would appear that the nardus Celtica was a plant of a quite different habit, and is ſuppoſed to have been a ſpecies of valeriana.

"The deſcription of the Nardus Indica by Pliny does not indeed correſpond with the appearance of our ſpecimen; for he ſays it is *frutex radice pingui et craſſa*, whereas ours has ſmall fibrous roots. But as Italy is very remote from the native country of this plant, it is reaſonable to ſuppoſe that others more eaſily procurable uſed to be ſubſtituted for it; and the ſame author ſays, that there were nine different plants by which it could be imitated and adulterated. There is a *Nardus Aſſyria* mentioned by Horace; and Dioſcorides mentions the *Nardus Syriaca* as a ſpecies different from the *Indica*, which certainly was brought from ſome of the remote parts of India; for both Dioſcorides and Galen, by way of fixing more particularly the country from whence it came, call it the *Nardus Gangites*. 3. *Garcias ab Horto*, a Portugueſe who reſided many years at Goa in the 16th century, has given a figure of the roots, or rather of the lower parts of the ſtalks, which correſponds with our ſpecimen; and he ſays that there is but this one ſpecies of nardus known in India, either for the conſumption of the natives, or for exportation to Perſia and Arabia. 4. The ſenſible qualities of this are ſuperior to what commonly paſſes for it in the ſhops, being poſſeſſed both of more fragrancy and pungency, which ſeems to account for the preference given to it by the ancients.

"There is a queſtion, concerning which Matthiolus, the commentator of Dioſcorides, beſtows a good deal of argument, viz. whether the roots or ſtalks were the parts eſteemed for uſe, the teſtimony of the ancients themſelves on this head being ambiguous. The roots of this ſpecimen are very ſmall, and poſſeſs ſenſible qualities inferior to the reſt of the plant; yet it is mentioned in the account above recited, that the virtues reſide principally in the huſky roots. It is evident, that by the huſky roots muſt here be meant the lower parts of the ſtalks and leaves, where they unite to the roots; and it is probably a ſlight ambiguity of this kind that has given occaſion to the ambiguity that occurs in the ancient accounts."

The ſenſible qualities of this plant do not depend upon an eſſential oil, but on ſome fixed principle like thoſe of cardamoms or ginger. Dr Blane tried to extract its virtues with boiling water, maceration in wine or proof ſpirits; but it yielded them ſparingly and with difficulty to any of theſe menſtrua. The Indians gave an infuſion of it in hot water, with a ſmall quantity of black pepper as a febrifuge.

Nardus, Narea. NAREA, the moſt ſoutherly province of the empire of Abyſſinia; a kingdom ſtill governed by its own princes, who have the title of *Beneros*. Its territory was formerly more extenſive than at preſent, the Galla having almoſt quite ſurrounded it, eſpecially on the ſouth-eaſt and north. The country to the weſt is the moſt unknown part of Africa; the kingdom itſelf ſtands like a fortified place in the middle of a plain, being an high and mountainous country. A great many rivers, riſing in the fourth and fifth degrees of north latitude, ſpread themſelves over the level part of the country, and fill it with marſhes all the way from ſouth by eaſt to north, or north-weſt.—Theſe marſhes are bounded by mountains, of which thoſe neareſt the marſhes are overgrown with coffee trees, the largeſt, if not the only ones, which grow in this country. The kingdom of Narea Proper is interſperſed with ſmall, unwholeſome, but very fertile

Narea, Narration.

valleys. The mountainous country of Caffa adjoins immediately to Narea, and is ſaid to be governed by a ſeparate prince; but the Galla having ſettled themſelves in all the flat ground to the very edge of the marſhes, have in a great meaſure cut off the communication with Abyſſinia for a long time paſt. The Nareans who inhabit the mountainous country have the lighteſt complexion of any people in Abyſſinia; but thoſe who inhabit the borders of the marſhes are perfectly black, and have the features and woolly heads of negroes; but the mountaineers of Narea, and much more thoſe of Caffa, are fair-complexioned, more ſo than even the Neapolitans or Sicilians. It is ſaid that ſnow has been ſeen to lie on ſome of the mountains of Caffa; but Mr Bruce imagines this to be a miſtake, and thinks that it muſt have been hail.

Narea abounds with cattle, grain, and all kinds of proviſions, both in the high and low country. The medium of commerce is gold, which they ſell by weight; but the principal articles of trade are coarſe cotton cloths, antimony, beads, and incenſe, which are carried from this country to the kingdom of Angola, and the parts of the African continent towards the Atlantic. The people are exceedingly brave; and though they have been driven out of the low country by multitudes of Galla, they now bid them defiance, and drive them from their frontiers whenever they come too near. The Narean priſoners taken in theſe ſkirmiſhes are ſold to the Mahometan merchants at Gondar; and at Conſtantinople, Cairo, or in India, the women are more eſteemed than thoſe of any other part of the world. Both ſexes have a cheerful, kind diſpoſition, and attach themſelves inviolably to their maſters, if properly treated. The people of Narea and Caffa ſpeak a language peculiar to themſelves.

NARRATION, in oratory, poetry, and hiſtory, a recital or rehearſal of a fact as it happened, or as it is ſuppoſed to have happened. See Oratory, n° 26. 123.

Concerning Narration *and Deſcription*, we have the following rules and obſervations in the Elements of Criticiſm.

1. The firſt rule is, That in hiſtory the reflections ought to be chaſte and ſolid; for while the mind is intent upon truth, it is little diſpoſed to the operation of the imagination. Strada's Belgic hiſtory is full of poetical images, which, being diſcordant with the ſubject, are unpleaſant; and they have a ſtill worſe effect, by giving an air of fiction to a genuine hiſtory. Such flowers ought to be ſcattered with a ſparing hand, even in epic poetry; and at no rate are they proper till the reader be warmed, and by an enlivened imagination be prepared to reliſh them: in that ſtate of mind, they are agreeable; but while we are ſedate and attentive to an hiſtorical chain of facts, we reject with diſdain every fiction.

2. Vida, following Horace, recommends a modeſt commencement of an epic poem; giving for a reaſon, that the writer ought to huſband his fire. Beſides, bold thoughts and figures are never reliſhed till the mind be heated and thoroughly engaged, which is not the reader's caſe at the commencement. Homer introduces not a ſingle ſimile in the firſt book of the Iliad, nor in the firſt book of the Odyſſey. On the other hand, Shakeſpeare begins one of his plays with a ſentiment too bold for the moſt heated imagination: Narration,

Bedford. Hung be the heav'ns with black, yield day to night!
Comets, importing change of times and ſtates,
Brandiſh your cryſtal treſſes in the ſky,
And with them ſcourge the bad revolting ſtars,
That have conſented unto Henry's death!
Henry the Fifth, too famous to live long!
England ne'er loſt a king of ſo much worth.
Firſt part Henry VI.

The paſſage with which Strada begins his hiſtory, is too poetical for a ſubject of that kind; and at any rate too high for the beginning of a grave performance.

3. A third rule or obſervation is, That where the ſubject is intended for entertainment ſolely, not for inſtruction, a thing ought to be deſcribed as it appears, not as it is in reality. In running, for example, the impulſe upon the ground is proportioned in ſome degree to the celerity of motion; though in appearance it is otherwiſe, for a perſon in ſwift motion ſeems to ſkim the ground, and ſcarcely to touch it. Virgil, with great taſte, deſcribes quick running according to appearance; and raiſes an image far more lively than by adhering ſcrupulouſly to truth:

Hos ſuper advenit Volſca de gente Camilla,
Agmen agens equitum et florentes ære catervas,
Bellatrix: non illa colo calathiſve Minervæ
Fœmineas aſſueta manus; ſed prælia virgo
Dura pati, curſuque pedum prævertere ventos.
Illa vel intactæ ſegetis per ſumma volaret
Gramina: nec teneras curſu læſiſſet ariſtas:
Vel mare per medium, fluctu ſuſpenſa tumenti,
Ferret iter: celeres nec tingeret æquore plantas.
Æneid. vii. 803.

4. In narration as well as in deſcription, objects ought to be painted ſo accurately as to form in the mind of the reader diſtinct and lively images. Every uſeleſs circumſtance ought indeed to be ſuppreſſed, becauſe every ſuch circumſtance loads the narration; but if a circumſtance be neceſſary, however ſlight, it cannot be deſcribed too minutely. The force of language conſiſts in raiſing complete images, which have the effect to tranſport the reader as by magic into the very place of the important action, and to convert him as it were into a ſpectator, beholding every thing that paſſes. The narrative in an epic poem ought to rival a picture in the livelineſs and accuracy of its repreſentations: no circumſtance muſt be omitted that tends to make a complete image; becauſe an imperfect image, as well as any other imperfect conception, is cold and unintereſting. We ſhall illuſtrate this rule by ſeveral examples, giving the firſt place to a beautiful paſſage from Virgil:

Qualis *populeâ* mœrens Philomela ſub umbrâ
Amiſſos queritur fœtus, quos durus *arator*
Obſervans nido *implumes* detraxit.
Georg. lib. 4. *l.* 511.

The poplar, plowman, and unfledged young, though not eſſential in the deſcription, tend to make a complete image, and upon that account are an embelliſhment.

Again:

Narration. Again:

Hic viridem Æneas *frondenti ex ilice* metam
Conſtituit, ſignum nautis. *Æneid.* v. 129.

Horace addreſſing to fortune:

Te pauper ambit ſollicita prece
Ruris colonus: te dominam æquoris,
Quicumque Bithynâ laceſſit
Carpathium pelagus carinâ.
Carm. lib. 1. *ode* 35.

—— Illum ex mœnibus hoſticis
Matrona bellantis tyranni
Proſpiciens, et adulta virgo,
Suſpiret: Eheu, ne rudis agminum
Sponſus laceſſat regius aſperum
Tactu leonem, quem cruenta
Per medias rapit ira cædes.
Carm. lib. 3. *ode* 2.

Shakeſpeare ſays, "You may as well go about to turn the ſun to ice by fanning in his face with a *peacock's* feather." The peacock's feather, not to mention the beauty of the object, completes the image: an accurate image cannot be formed of that fanciful operation, without conceiving a particular feather; and one is at a loſs when this is neglected in the deſcription. Again, "The rogues ſlighted me into the river with as little remorſe, as they would have drown'd a bitch's blind puppies, fifteen i' th' litter."

Old Lady. You would not be a queen?
Anne. No, not for all the riches under heaven.
Old Lady. 'Tis ſtrange: a three-pence bow'd would hire me, old as I am, to queen it.
Henry VIII. act 2. *ſc.* 5.

In the following paſſage, the action, with all its material circumſtances, is repreſented ſo much to the life, that it would ſcarce appear more diſtinct to a real ſpectator; and it is the manner of deſcription that contributes greatly to the ſublimity of the paſſage.

He ſpake; and, to confirm his words, out flew
Millions of flaming ſwords, drawn from the thighs
Of mighty cherubim; the ſudden blaze
Far round illumin'd hell: highly they rag'd
Againſt the Higheſt, and fierce with graſped arms,
Claſh'd on their ſounding ſhields the din of war,
Hurling defiance toward the vault of heav'n.
Milton, b. 1.

The following paſſage from Shakeſpeare falls not much ſhort of that now mentioned in particularity of deſcription:

O you hard hearts! you cruel men of Rome!
Knew you not Pompey? Many a time and oft
Have you climb'd up to walls and battlements,
To tow'rs and windows, yea, to chimney-tops,
Your infants in your arms; and there have ſat
The live-long day with patient expectation
To ſee great Pompey paſs the ſtreets of Rome;
And when you ſaw his chariot but appear,
Have you not made an univerſal ſhout,
That Tyber trembled underneath his banks,
To hear the replication of your ſounds,
Made in his concave ſhores?
Julius Cæſar, act 1. *ſc.* 1.

The following paſſage is ſcarce inferior to either of thoſe mentioned: Narration.

"Far before the reſt, the ſon of Oſſian comes: bright in the ſmiles of youth, fair as the firſt beams of the ſun. His long hair waves on his back: his dark brow is half beneath his helmet. The ſword hangs looſe on the hero's ſide; and his ſpear glitters as he moves. I fled from his terrible eye, King of high Temora."
Fingal.

The Henriade of Voltaire errs greatly againſt the foregoing rule: every incident is touched in a ſummary way, without ever deſcending to circumſtances. This manner is good in a general hiſtory, the purpoſe of which is to record important tranſactions: but in a fable it is cold and unintereſting; becauſe it is impracticable to form diſtinct images of perſons or things repreſented in a manner ſo ſuperficial.

It is obſerved above, that every uſeleſs circumſtance ought to be ſuppreſſed. The crowding ſuch circumſtances is, on the one hand, not leſs to be avoided, than the conciſeneſs for which Voltaire is blamed, on the other. In the Æneid, Barce, the nurſe of Sichæus, whom we never hear of before nor after, is introduced for a purpoſe not more important than to call Anna to her ſiſter Dido: and that it might not be thought unjuſt in Dido, even in this trivial circumſtance, to prefer her huſband's nurſe before her own, the poet takes care to inform his reader, that Dido's nurſe was dead. To this may be oppoſed a beautiful paſſage in the ſame book, where, after Dido's laſt ſpeech, the poet, without detaining his readers by deſcribing the manner of her death, haſtens to the lamentation of her attendants:

Dixerat: atque illam media inter talia ferro
Collapſam aſpiciunt comites, enſemque cruore
Spumantem, ſparſaſque manus. It clamor ad alta
Atria, concuſſam bacchatur fama per urbem;
Lamentis gemituque et fœmineo ululatu
Tecta fremunt, reſonat magnis plangoribus æther.
Lib. 4. l. 663.

As an appendix to the foregoing rule, may be added the following obſervation, That to make a ſudden and ſtrong impreſſion, ſome ſingle circumſtance, happily ſelected, has more power than the moſt laboured deſcription. Macbeth, mentioning to his lady ſome voices he heard while he was murdering the King, ſays,

There's one did laugh in ſleep, and one cry'd Murder!
They wak'd each other; and I ſtood and heard them;
But they did ſay their prayers, and addreſs them
Again to ſleep.
Lady. There are two lodg'd together.
Macbeth. One cry'd, God bleſs us! and, Amen! the other;
As they had ſeen me with theſe hangman's hands.
Liſtening their fear, I could not ſay, Amen,
When they did ſay, God bleſs us.
Lady. Conſider it not ſo deeply.
Macbeth. But wherefore could not I pronounce Amen?
I had moſt need of bleſſing, and Amen
Stuck in my throat.

Lady.

Narration.

Lady. Theſe deeds muſt not be thought
After theſe ways; ſo, it will make us mad.
Macbeth. Methought, I heard a voice cry,
Sleep no more!
Macbeth doth murder ſleep, &c. *Act 2. ſc. 3.*

Deſcribing prince Henry:

I ſaw young Harry, with his beaver on,
His cuiſſes on his thighs, gallantly arm'd,
Riſe from the ground like feather'd Mercury;
And vaulted with ſuch eaſe into his ſeat,
As if an angel dropt down from the clouds,
To turn and wind a fiery Pegaſus,
And witch the world with noble horſemanſhip.
Firſt part Henry IV. act 4. ſc. 2.

King Henry. Lord Cardinal, if thou think'ſt on
Heaven's bliſs.
Hold up thy hand, make ſignal of thy hope.
He dies, and makes no ſign!
Second part Henry VI. act. 3. ſc. 10.

The ſame author, ſpeaking ludicrouſly of an army debilitated with diſeaſes, ſays,

"Half of them dare not ſhake the ſnow from off their caſſocks, leſt they ſhake themſelves to pieces."

"I have ſeen the walls of Balclutha, but they were deſolate. The flames had reſounded in the halls: and the voice of the people is heard no more. The ſtream of Clutha was removed from its place by the fall of the walls. The thiſtle ſhook there its lonely head: the moſs whiſtled to the wind. The fox looked out from the windows; and the rank graſs of the wall waved round his head. Deſolate is the dwelling of Morna: ſilence is in the houſe of her fathers." *Fingal.*

To draw a character is the maſter ſtroke of deſcription. In this Tacitus excels: his portraits are natural and lively, not a feature wanting or miſplaced. Shakeſpeare, however, exceeds Tacitus in livelineſs; ſome characteriſtical circumſtance being generally invented or laid hold of, which paints more to the life than many words. The following inſtances will explain our meaning, and at the ſame time prove our obſervation to be juſt.

Why ſhould a man, whoſe blood is warm within,
Sit like his grandſire cut in alabaſter?
Sleep when he wakes, and creep into the jaundice,
By being peeviſh? I tell thee what, Anthonio,
(I love thee, and it is my love that ſpeaks),
There are a ſort of men, whoſe viſages
Do cream and mantle like a ſtanding pond;
And do a wilful ſtillneſs entertain,
With purpoſe to be dreſs'd in an opinion
Of wiſdom, gravity, profound conceit;
As who ſhould ſay, I am Sir Oracle,
And when I ope my lips, let no dog bark!
O my Anthonio! I do know of thoſe,
That therefore only are reputed wiſe,
For ſaying nothing.
Merchant of Venice, act. 1. ſc. 2.

Again:

"Gratiano ſpeaks an infinite deal of nothing, more than any man in all Venice: his reaſons are two grains of wheat hid in two buſhels of chaff; you ſhall ſeek all day ere you find them; and when you have them, they are not worth the ſearch." *Ibid.*

In the following paſſage, a character is completed by a ſingle ſtroke: Narration.

Shallow. O the mad days that I have ſpent; and to ſee how many of mine old acquaintance are dead.
Silence. We ſhall all follow, couſin.
Shallow. Certain, 'tis certain, very ſure, very ſure; Death (as the Pſalmiſt ſaith) is certain to all: all ſhall die. How good a yoke of bullocks at Stamford fair?
Slender. Truly, couſin, I was not there.
Shallow. Death is certain. Is old *Double* of your town living yet?
Silence. Dead, Sir.
Shallow. Dead! ſee, ſee; he drew a good bow: and dead. He ſhot a fine ſhoot. How a ſcore of ewes now?
Silence. Thereafter as they be. A ſcore of good ewes may be worth ten pounds.
Shallow. And is old *Double* dead?
Second Part Henry IV. act. 3. ſc. 3.

Deſcribing a jealous huſband:

"Neither preſs, coffer, cheſt, trunk, well, vault, but he hath an abſtract for the remembrance of ſuch places, and goes to them by his note. There is no hiding you in the houſe." *Merry Wives of Windſor, act. 4. ſc. 3.*

Congreve has an inimitable ſtroke of this kind in his comedy of *Love for Love:*

Ben Legend. Well, father, and how do all at home? how does brother Dick, and brother Val?
Sir Sampſon. Dick, body o' me, Dick has been dead theſe two years. I writ you word when you were at Leghorn.
Ben. Meſs, that's true; marry, I had forgot. Dick's dead, as you ſay. *Act 3. ſc. 6.*

Falſtaff ſpeaking of Ancient Piſtol:

"He's no ſwaggerer, hoſteſs; a tame cheater i'faith; you may ſtroak him as gently as a puppy-greyhound; he will not ſwagger with a Barbary hen, if her feathers turn back in any ſhow of reſiſtance."
Second part Henry IV. act 2. ſc. 9.

Oſſian among his other excellencies is eminently ſucceſsful in drawing characters; and he never fails to delight his reader with the beautiful attitudes of his heroes. Take the following inſtances:

"O Oſcar! bend the ſtrong in arm; but ſpare the feeble hand. Be thou a ſtream of many tides againſt the foes of thy people; but like the gale that moves the graſs to thoſe who aſk thine aid.—So Trenmor lived; ſuch Trathal was; and ſuch has Fingal been. My arm was the ſupport of the injured; and the weak reſted behind the lightning of my ſteel."

"We heard the voice of joy on the coaſt, and we thought that the mighty Cathmor came. Cathmor the friend of ſtrangers! the brother of red-haired Cairbar! But their ſouls were not the ſame; for the light of heaven was in the boſom of Cathmor. His towers roſe on the banks of Atha: ſeven paths led to his halls: ſeven chiefs ſtood on theſe paths, and called the ſtranger to the feaſt. But Cathmor dwelt in the wood to avoid the voice of praiſe."

"Dermid and Oſcar were one: they reaped the battle together. Their friendſhip was ſtrong as their ſteel;

Narration.

steel; and death walked between them to the field. They rush on the foe like two rocks falling from the brow of Ardven. Their swords are stained with the blood of the valiant: warriors faint at their name. Who is equal to Oscar but Dermid? who to Dermid but Oscar?"

"Son of Comhal, replied the chief, the strength of Morni's arm has failed: I attempted to draw the sword of my youth, but it remains in its place: I throw the spear, but it falls short of the mark: and I feel the weight of my shield. We decay like the grass of the mountain, and our strength returns no more. I have a son, O Fingal! his soul has delighted in the actions of Morni's youth; but his sword has not been fitted against the foe, neither has his fame begun. I come with him to battle, to direct his arm. His renown will be a sun to my soul, in the dark hour of my departure. O that the name of *Morni* were forgot among the people! that the heroes would only say, *Behold the father of Gaul.*"

Some writers, through heat of imagination, fall into contradiction; some are guilty of downright absurdities; and some even rave like madmen. Against such capital errors one cannot be more effectually warned than by collecting instances; and the first shall be of a contradiction, the most venial of all. Virgil speaking of Neptune,

Interea magno misceri murmure pontum,
Emissamque hyemem sensit Neptunus, et imis
Stagna refusa vadis: *graviter commotus*, et alto
Prospiciens, summâ *placidum* caput extulit undâ.
Æneid. i. 128.

Again:

When first young Maro, in his boundless mind,
A work t'outlast *immortal* Rome design'd.
Essay on Criticism, l. 30.

The following examples are of absurdities.

"Alii pulsis e tormento catenis discerpti sectique, dimidiato corpore pugnabant sibi superstites, ac peremptæ partis ultores." *Strada, dec.* 2. *l.* 2.

Il povér huomo, che non sen' era accorto,
Andava combattendo, ed era morto. *Berni.*

He fled, but flying, left his life behind.
Iliad, xi. 443.

Full through his neck the weighty falchion sped:
Along the pavement roll'd the mutt'ring head.
Odyssey, xxii. 365.

The last article is of raving like one mad. Cleopatra speaking to the aspic,

——————Welcome, thou kind deceiver,
Thou best of thieves; who, with an easy key,
Dost open life, and unperceiv'd by us
Ev'n steal us from ourselves; discharging so
Death's dreadful office, better than himself;
Touching our limbs so gently into slumber,
That Death stands by, deceiv'd by his own image,
And thinks himself but sleep.
Dryden, All for Love, act 5.

Having discussed what observations occurred upon the thoughts or things expressed, we proceed to what more peculiarly concerns the language or verbal dress.

As words are intimately connected with the ideas they represent, the emotions raised by the sound and by the sense ought to be concordant. An elevated subject requires an elevated style; what is familiar, ought to be familiarly expressed: a subject that is serious and important, ought to be clothed in plain nervous language: a description, on the other hand, addressed to the imagination, is susceptible of the highest ornaments that sounding words and figurative expression can bestow upon it.

We shall give a few examples of the foregoing rules. A poet of any genius is not apt to dress a high subject in low words; and yet blemishes of that kind are found even in classical works. Horace, observing that men are satisfied with themselves, but seldom with their condition, introduces Jupiter indulging to each his own choice:

Jam faciam quod vultis; eris tu, qui modo miles,
Mercator: tu, consultus modo, rusticus: hinc vos,
Vos hinc mutatis discedite partibus: eia,
Quid statis? nolint: atqui licet esse beatis.
Quid causæ est, merito quin illis *Jupiter ambas*
Iratus buccas inflet? neque se fore posthac
Tam facilem dicat, votis ut præbeat aurem?
Sat. lib. 1. *sat.* 1. *l.* 16.

Jupiter in wrath puffing up both cheeks, is a low and even ludicrous expression, far from suitable to the gravity and importance of the subject: every one must feel the discordance. The following couplet, sinking far below the subject, is no less ludicrous:

Not one looks backward, onward still he goes,
Yet ne'er looks forward farther than his nose.
Essay on Man, ep. iv. 223.

On the other hand, to raise the expression above the tone of the subject, is a fault than which none is more common. Take the following instances:

Orcan le plus fidéle à server ses desseins,
Ne sous le ciel brûlant des plus noirs Affricains.
Bajacet, act 3. *sc.* 8.

Les ombres par trois fois ont obscurci les cieux
Depuis que le sommeil n'est entré dans vos yeux;
Et le jour a trois fois chassé la nuit obscure
Depuis que votre corps languit sans nourriture.
Phedra, act 1. *sc.* 3.

Assueris. Ce mortel, qui montra tant de zéle pour moi, Vit-il encore?
Asaph.——Il voit l'astre qui vous éclaire.
Esther, act 2. *sc.* 3.

Oui, c'est Agamemnon, c'est ton roi qui t'eveille;
Viens, reconnois la voix qui frappe ton oreille.
Iphigenie.

No jocund health that Denmark drinks to-day,
But the great cannon to the clouds shall tell;
And the king's rowse the heav'n shall bruit again,
Respeaking earthly thunder.
Hamlet, act 1. *sc.* 2.

——————In the inner room
I spy a winking lamp, that weakly strikes
The ambient air, scarce kindling into light.
Southerne, Fate of Capua, act 3.

In the funeral orations of the bishop of Meaux, the following passages are raised far above the tone of the subject:

"L'Ocean etonné de se voir traversé tant de fois, èn

Narration. des appareils ſi divers, et pour des cauſes ſi differentes, &c." *p.* 6.

" Grande reine, je ſatisfais à vos plus tendres deſirs, quand je célébre ce monarque ; et ſon cœur qui n'a jamais vêcu qui pour lui, ſe eveille, tout poudre qu'il eſt, et devient ſenſible, même ſous ce drap mortuaire, au nom d'un epoux ſi cher" *p.* 32.

The following paſſage, intended, one would imagine, as a receipt to boil water, is altogether burleſque by the laboured elevation of the diction :

A maſſy cauldron of ſtupendous frame
They brought, and plac'd it o'er the riſing flame :
Then heap the lighted wood ; the flame divides
Beneath the vaſe, and climbs around the ſides :
In its wide womb they pour the ruſhing ſtream :
The boiling water bubbles to the brim.
Iliad. xviii. 405.

In a paſſage at the beginning of the 4th book of Telemachus, one feels a ſudden bound upward without preparation, which accords not with the ſubject :

" Calypſo, qui avoit été juſqu' à ce moment immobile et tranſportée de plaiſir en écoutant les avantures de Télémaque, l'interrompit pour lui faire prendre quelque repôs. Il eſt tems, lui dit-elle, que vous alliez goûter la douceur du ſommeil apprés tant de travaux. Vous n'avez rien à craindre ici ; tout vous eſt favorable. Abandonnez vous donc à la joye. Goutez la paix, et tous les autres dons des dieux dont vous allez être comblé. Demain, *quand l'Aurore avec ſes doigts de rôſes entr'ouvira les portes dorées de l'Orient, et que le chevaux du ſoleil ſortans de l'onde amére répandront les flames du jour, pour chaſſer devant eux toutes les etoiles du ciel*, nous reprendrons, mon cher Télémaque, l'hiſtoire de vos malheurs."

This obviouſly is copied from a ſimilar paſſage in the Æneid, which ought not to have been copied, becauſe it lies open to the ſame cenſure ; but the force of authority is great :

At regina gravi jamdudum ſaucia cura
Vulnus alit venis, et cæco carpitur igni.
Multa viri virtus animo, multuſque recurſat
Gentis honos : hærent infixi pectore vultus,
Verbaque : nec placidam membris dat cura quietem.
Poſtera Phœbea luſtrabat lampade terras,
Humentemque Aurora polo dimoverat umbram ;
Cum ſic unanimem alloquitur maleſana ſororem.
Lib. iv. 1.

The language of Homer is ſuited to his ſubject, not leſs accurately than the actions and ſentiments of his heroes are to their characters. Virgil, in that particular, falls ſhort of perfection : his language is ſtately throughout : and though he deſcends at times to the ſimpleſt branches of cookery, roaſting and boiling for example, yet he never relaxes a moment from the high tone.—In adjuſting his language to his ſubject, no writer equals Swift. We can recollect but one exception, which at the ſame time is far from being groſs : The Journal of a modern Lady is compoſed in a ſtyle blending ſprightlineſs with familiarity, perfectly ſuited to the ſubject : in one paſſage, however, the poet, deviating from that ſtyle, takes a tone above his ſubject. The paſſage we have in view begins *l.* 116. But *let me now a while ſurvey, &c.* and ends at *l.* 135. Narration.

It is proper to be obſerved upon this head, that writers of inferior rank are continually upon the ſtretch to enliven and enforce their ſubject by exaggeration and ſuperlatives. This unluckily has an effect contrary to what is intended : the reader, diſguſted with language that ſwells above the ſubject, is led by contraſt to think more meanly of the ſubject than it may poſſibly deſerve. A man of prudence, beſide, will be no leſs careful to huſband his ſtrength in writing than in walking : a writer, too liberal of ſuperlatives, exhauſts his whole ſtock upon ordinary incidents, and reſerves no ſhare to expreſs, with greater energy, matters of importance.

Many writers of that kind abound ſo in epithets, as if poetry conſiſted entirely in high-ſounding words. Take the following inſtance :

When black-brow'd night her duſky mantle ſpread,
And wrapt in ſolemn gloom the ſable ſky ;
When ſoothing ſleep her opiate dews had ſhed,
And ſeal'd in ſilken ſlumbers every eye :
My waking thought admits no balmy reſt,
Nor the ſweet bliſs of ſoft oblivion ſhare :
But watchful wo diſtracts my aching breaſt,
My heart the ſubject of corroding care :
From haunts of men with wandring ſteps and ſlow
I ſolitary ſteal, and ſoothe my penſive wo.

Here every ſubſtantive is faithfully attended by ſome tumid epithet.

We proceed to a ſecond remark, not leſs important than the former. No perſon of reflection but muſt be ſenſible, that an incident makes a ſtronger impreſſion on an eye-witneſs, than when heard at ſecond-hand Writers of genius, ſenſible that the eye is the beſt avenue to the heart, repreſent every thing as paſſing in our ſight ; and, from readers or hearers, transform us as it were into ſpectators: a ſkilful writer conceals himſelf, and preſents his perſonages: in a word, every thing becomes dramatic as much as poſſible. Plutarch, *de gloria Athenienſium*, obſerves, that Thucydides makes his reader a ſpectator, and inſpires him with the ſame paſſions as if he were an eye-witneſs.

In the fine arts, it is a rule to put the capital objects in the ſtrongeſt point of view ; and even to preſent them oftener than once, where it can be done. In hiſtory-painting, the principal figure is placed in the front, and in the beſt light : an equeſtrian ſtatue is placed in a centre of ſtreets, that it may be ſeen from many places at once. In no compoſition is there greater opportunity for this rule than in writing :

——Sequitur pulcherrimus Aſtur,
Aſtur equo fidens et verſicoloribus armis.
Æneid. x. 180.

——Full many a lady
I've ey'd with beſt regard, and many a time
Th' harmony of their tongues hath into bondage
Brought my too diligent ear : for ſeveral virtues
Have I lik'd ſeveral women ; never any
With ſo full ſoul, but ſome defect in her
Did quarrel with the nobleſt grace ſhe ow'd,
And put it to the foil. But you, O you,
So perfect, and ſo peerleſs, are created
Of every creature's beſt. *Tempeſt, act* 3. *ſc.* 1.
Orlando.

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Orlando.——Whate'er you are
That, in the deſart inacceſſible,
Under the ſhade of melancholy boughs,
Loſe and neglect the creeping hours of time;
If ever you have look'd on better days;
If ever been where bells have knoll'd to church;
If ever ſat at any good man's feaſt;
If ever from your eye-lids wip'd a tear,
And know what 'tis to pity, and be pity'd;
Let gentleneſs my ſtrong inforcement be,
In the which hope I bluſh, and hide my ſword.

Duke ſen. True is it that we have ſeen better days;
And have with holy bell been knoll'd to church;
And ſat at good mens feaſts; and wip'd our eyes
Of drops that ſacred pity had engender'd:
And therefore ſit you down in gentleneſs,
And take upon command what help we have,
That to your wanting may be miniſtred.

As you like it.

With the converſing I forgot all time;
All ſeaſons and their change, all pleaſe alike.
Sweet is the breath of morn, her riſing ſweet,
With charm of earlieſt birds; pleaſant the ſun
When firſt on this delightful land he ſpreads
His orient beams on herbs, tree, fruit, and flow'r
Gliſtring with dew; fragrant the fertile earth
After ſoft ſhow'rs; and ſweet the coming on
Of grateful ev'ning mild, the ſilent night
With this her ſolemn bird, and this fair moon,
And theſe the gems of heav'n, her ſtarry train:
But neither breath of morn, when ſhe aſcends
With charm of earlieſt birds, nor riſing ſun
On this delightful land, nor herb, fruit, flow'r,
Gliſt'ring with dew, nor fragrance after ſhow'rs,
Nor grateful ev'ning mild, nor ſilent night,
With this her ſolemn bird, nor walk by moon,
Or glittering ſtar-light, without thee is ſweet.

Paradiſe Loſt, book 4. *l.* 634.

"What mean ye, that ye uſe this proverb, The fathers have eaten ſour grapes, and the childrens teeth are ſet on edge? As I live, ſaith the Lord God, ye ſhall not have occaſion to uſe this proverb in Iſrael. If a man keep my judgments to deal truly, he is juſt, he ſhall ſurely live. But if he be a robber, a ſhedder of blood; if he have eaten upon the mountains, and defiled his neighbour's wife; if he have oppreſſed the poor and needy, have ſpoiled by violence, have not reſtored the pledge, have lift up his eyes to idols, have given forth upon uſury, and have taken increaſe: ſhall he live? he ſhall not live: he ſhall ſurely die; and his blood ſhall be upon him. Now, lo, if he beget a ſon, that ſeeth all his father's ſins, and conſidereth, and doeth not ſuch like; that hath not eaten upon the mountains, hath not lift up his eyes to idols, nor defiled his neighbour's wife, hath not oppreſſed any, nor withheld the pledge, neither hath ſpoiled by violence, but hath given his bread to the hungry, and covered the naked with a garment; that hath not received uſury nor increaſe, that hath executed my judgments, and walked in my ſtatutes: he ſhall not die for the iniquity of his father; he ſhall ſurely live. The ſoul that ſinneth, it ſhall die; the ſon ſhall not bear the iniquity of the father, neither ſhall the father bear the iniquity of the ſon; the righteouſneſs of the righteous ſhall be upon him, and the wickedneſs of the wicked ſhall be upon him. Have I any pleaſure that the wicked ſhould die, ſaith the Lord God; and not that he ſhould return from his ways, and live?" *Ezekiel* xvii. Narration.

A conciſe comprehenſive ſtyle is a great ornament in narration; and a ſuperfluity of unneceſſary words, not leſs than of circumſtances, a great nuiſance. A judicious ſelection of the ſtriking circumſtances, clothed in a nervous ſtyle, is delightful. In this ſtyle, Tacitus excels all writers, ancient and modern. Inſtances are numberleſs: take the following ſpecimen:

"Crebra hinc prælia, et ſæpius in modum latrocinii: per ſaltus, per paludes; ut cuique fors aut virtus: temerè, proviſo, ob iram, ob prædam, juſſu, et aliquando ignaris ducibus." *Annal. lib.* 12. § 39.

After Tacitus, Oſſian in that reſpect juſtly merits the place of diſtinction. One cannot go wrong for examples in any part of the book.

If a conciſe or nervous ſtyle be a beauty, tautology muſt be a blemiſh; and yet writers, fettered by verſe, are not ſufficiently careful to avoid this ſlovenly practice: they may be pitied, but they cannot be juſtified. Take for a ſpecimen the following inſtances, from the beſt poet, for verſification at leaſt, that England has to boaſt of:

High on his helm celeſtial lightnings play,
His beamy ſhield emits a living ray;
Th' unweary'd blaze inceſſant ſtreams ſupplies,
Like the red ſtar that fires the autumnal ſkies.
Iliad v. 5.

Strength and omnipotence inveſt thy throne.
Ibid. viii. 576.

So ſilent fountains, from a rock's tall head,
In ſable ſtreams ſoft trickling waters ſhed.
Ibid. ix. 19.

His clanging armour rung. *Ibid.* xii. 94.

Fear on their cheek, and horror in their eye.
Ibid. xv. 4.

The blaze of armour flaſh'd againſt the day.
Ibid. xvii. 736.

As when the piercing blaſts of Boreas blow.
Ibid. xix. 380.

And like the moon, the broad refulgent ſhield
Blaz'd with long rays, and gleam'd athwart the field.
Ibid. xix. 402.

No—could our ſwiftneſs o'er the winds prevail,
Or beat the pinions of the weſtern gale,
All were in vain—— *Ibid.* xix. 604.

The humid ſweat from ev'ry pore deſcends.
Ibid. xxiii. 829.

We cloſe this article with a curious inquiry. An object, however ugly to the ſight, is far from being ſo when repreſented by colours or by words. What is the cauſe of this difference? With reſpect to painting, the cauſe is obvious: a good picture, whatever the ſubject be, is agreeable by the pleaſure we take in imitation; and this pleaſure overbalancing the diſagreeableneſs of the ſubject, makes the picture upon the whole agreeable. With reſpect to the deſcription of an ugly object, the cauſe follows. To connect individuals in the ſocial ſtate, no particular contributes more than language, by the power it poſſeſſes of an expeditious communication of thought, and a lively repreſentation of tranſactions. But nature hath not

Narration. been ſatisfied to recommend language by its utility merely: independent of utility, it is made ſuſceptible of many beauties, which are directly felt, without any intervening reflection. And this unfolds the myſtery; for the pleaſure of language is ſo great, as in a lively deſcription to overbalance the diſagreeableneſs of the image raiſed by it. This, however, is no encouragement to chooſe a diſagreeable ſubject; for the pleaſure is incomparably greater where the ſubject and the deſcription are both of them agreeable.

The following deſcription is upon the whole agreeable, though the ſubject deſcribed is in itſelf diſmal:

Nine times the ſpace that meaſures day and night
To mortal men, he with his horrid crew
Lay vanquiſh'd, rolling in the fiery gulf,
Confounded though immortal! but his doom
Reſerv'd him to more wrath; for now the thought
Both of loſt happineſs and laſting pain
Torments him; round he throws his baleful eyes
That witneſs'd huge affliction and diſmay:
Mix'd with obdurate pride and ſtedfaſt hate:
At once as far as angels ken he views
The diſmal ſituation waſte and wild:
A dungeon horrible, on all ſides round
As one great furnace flamed; yet from thoſe flames
No light, but rather darkneſs viſible
Serv'd only to diſcover ſights of wo,
Regions of ſorrow, doleful ſhades, where peace
And reſt can never dwell, hope never comes
That comes to all; but torture without end
Still urges, and a fiery deluge, fed
With ever-burning ſulphur unconſum'd!
Such place eternal juſtice had prepar'd
For thoſe rebellious. *Paradiſe Loſt, book* 1. *l.* 50.

An unmanly depreſſion of ſpirits in time of danger is not an agreeable ſight; and yet a fine deſcription or repreſentation of it will be reliſhed:

K. Richard. What muſt the king do now? muſt he ſubmit?
The king ſhall do it: muſt he be depos'd?
The king ſhall be contented: muſt he loſe
The name of king? o' God's name let it go;
I'll give my jewels for a ſet of beads;
My gorgeous palace, for a hermitage;
My gay apparel, for an almſman's gown;
My figur'd goblets, for a diſh of wood;
My ſceptre, for a palmer's walking ſtaff;
My ſubjects, for a pair of carved ſaints;
And my large kingdom, for a little grave;
A little, little grave,——an obſcure grave.
Or I'll be bury'd in the king's highway;
Some way of common tread, where ſubjects feet
May hourly trample on their ſovereign's head;
For on my heart they tread now, whilſt I live;
And, bury'd once, why not upon my head?
Richard II. act 3. *ſc.* 6.

Objects that ſtrike terror in a ſpectator, have in poetry and painting a fine effect. The picture, by raiſing a ſlight emotion of terror, agitates the mind; and in that condition every beauty makes a deep impreſſion. May not contraſt heighten the pleaſure, by oppoſing our preſent ſecurity to the danger of encountering the object repreſented?

——————————The other ſhape,
If ſhape it might be call'd that ſhape had none
Diſtinguiſhable in member, joint, or limb;
Or ſubſtance might be call'd that ſhadow ſeem'd,
For each ſeem'd either; black it ſtood as night,
Fierce as ten furies, terrible as hell,
And ſhook a dreadful dart. *Par. Loſt, b.* 2. *l.* 666.

——————————Now ſtorming fury roſe,
And clamour ſuch as heard in heaven till now
Was never: arms on clamour claſhing bray'd
Horrible diſcord, and the madding wheels
Of brazen chariots rage; dire was the noiſe
Of conflict; overhead the diſmal hiſs
Of fiery darts in flaming vollies flew,
And flying vaulted either hoſt with fire.
So under fiery cope together ruſh'd
Both battles main, with ruinous aſſault
And inextinguiſhable rage: all heaven
Reſounded, and had earth been then, all earth
Had to her centre ſhook. *Ibid. book* 6. *l.* 207.

Ghoſt. —————— But that I am forbid
To tell the ſecrets of my priſon-houſe,
I could a tale unfold, whoſe lighteſt word
Would harrow up thy ſoul, freeze thy young blood,
Make thy two eyes, like ſtars, ſtart from their ſpheres,
Thy knotty and combined locks to part,
And each particular hair to ſtand on end,
Like quills upon the fretful porcupine:
But this eternal blazon muſt not be
To ears of fleſh and blood. *Hamlet, act* 1. *ſc.* 8.

Gratiano. Poor Deſdemona! I'm glad thy father's dead:
Thy match was mortal to him; and pure grief
Shore his old thread in twain. Did he live now,
This ſight would make him do a deſp'rate turn:
Yea, curſe his better angel from his ſide,
And fall to reprobation. *Othello, act* 5. *ſc.* 8.

Objects of horror muſt be excepted from the foregoing theory; for no deſcription, however lively, is ſufficient to overbalance the diſguſt raiſed even by the idea of ſuch objects. Every thing horrible ought therefore to be avoided in a deſcription.

NARSES, the eunuch who rivalled Beliſarius in heroiſm under the reign of the emperor Juſtinian, emerged from obſcurity A.D. 538. From the domeſtic ſervice of the palace, and the adminiſtration of the private revenue, he was ſuddenly exalted to the head of an army. He is ranked among the few eunuchs who have reſcued that unhappy name from the contempt and hatred of mankind. A feeble diminutive body concealed the ſoul of a ſtateſman and a warrior. His youth had been employed in the management of the loom and diſtaff, in the cares of the houſehold, and the ſervice of female luxury; but, while his hands were buſy, he ſecretly exerciſed the faculties of a vigorous and diſcerning mind. A ſtranger to the ſchools and the camp, he ſtudied in the palace to diſſemble, to flatter, and to perſuade; and as ſoon as he approached the perſon of the emperor, Juſtinian liſtened with ſurpriſe and pleaſure to the manly counſels of his chamberlain and private treaſurer. The talents of Narſes were tried and improved in frequent embaſſies; he led an army into Italy, acquired a practical

Narration, Narſes.

Narſes || Naſſau.

tical knowledge of the war and the country, and preſumed to ſtrive with the genius of Beliſarius. Twelve years after his return, the eunuch was choſen to atchieve the conqueſt which had been left imperfect by the firſt of the Roman generals. Inſtead of being dazzled by vanity or emulation, he ſeriouſly declared, that unleſs he were armed with an adequate force, he would never conſent to riſk his own glory and that of his ſovereign. Juſtinian granted to the favourite what he might have denied to the hero: the Gothic war was rekindled from its aſhes, and the preparations were not unworthy of the ancient majeſty of the empire.

Narſes defeated the Goths, the Franks, and the Alemanni; the Italian cities opened their gates to the conqueror; he entered the capital in triumph; and having eſtabliſhed the ſeat of his government at Ravenna, continued 15 years to govern Italy under the title of *Exarch*.

His virtues, we are told, were ſtained with avarice; and in this provincial reign he accumulated a treaſure of gold and ſilver which ſurpaſſed the modeſty of a private fortune. His government was oppreſſive or unpopular; and the general diſcontent was expreſſed with freedom by the deputies of Rome. Before the throne of Juſtinian they boldly declared, that their Gothic ſervitude had been more tolerable than the deſpotiſm of a Greek eunuch; and that unleſs their tyrant were inſtantly removed, they would conſult their own happineſs in the choice of a maſter. Thus was his diſgrace the effect of the people's diſaffection; and his death, though in the extreme period of old age, was unſeaſonable and premature, ſince his genius alone could have repaired the laſt and fatal error of his life. He died about the year 567, and, as ſome ſay, at the advanced age of 95; but this does not appear very probable. See Gibbon's Rom. Hiſt. vol. iv. 4to edit. p. 194, 298, &c.

NARVA, a ſtrong town of the Ruſſian empire, in Livonia, with a caſtle and a harbour. It was taken by the Muſcovites from the Danes in 1558, by the Swedes in 1581, and they defeated the Muſcovites near it in 1700; but it was retaken by the Ruſſians in 1704 by ſtorm, and the inhabitants ſent to Aſtracan. It is ſeated on the river Narva, 95 miles S.W. of Wiburg, and 172 N.E. of Riga. E. Long. 29. 0. N. Lat. 59. 8.

NARWAL, in ichthyology. See MONODON.

NASSAU-SIEGEN, a ſmall principality of Germany in the Weſterwalde, is in general a mountainous woody country, with ſome arable and paſture ground, and a good breed of cattle. Its manufactures are chiefly thoſe of iron and ſteel, having an iron mine in the neighbourhood of Siegen. Count John the Younger, in 1626, embraced the Roman Catholic religion, and endeavoured to introduce it into the country; but the principality, upon the extinction of the line of Naſſau-Siegen in 1743, falling to the line of Naſſau-Dietz, and therein to the prince of Orange, hereditary ſtadtholder of the United Provinces, the Proteſtants were delivered from their apprehenſions of Popiſh tyranny and bigotry. The prince, on account of theſe territories, has a ſeat and voice at the diets of the empire and circle in the college of princes. His aſſeſſment in the matricula for Naſſau-Siegen is 773 florins monthly; and towards the maintenance of the chamber-judicatory, 50 rix-dollars ſix kruitzers and a half each term. The revenue of this principality is eſtimated at 100,000 rix-dollars.

Naſſau || National.

Nassau-Dillenbourg, a principality of Germany, ſituated near the former. It has not much arable land, but plenty of wood, good quarries of ſtone, ſome ſilver and vitriol, copper and lead, with ſtore of iron, for the working and ſmelting of which there are many forges and founderies in the country; and by theſe, and the ſale of their iron, the inhabitants chiefly ſubſiſt. Calviniſm is the religion of the principality, which contains five towns and two boroughs, and belongs entirely to William V. prince of Orange, and hereditary ſtadtholder of the United Provinces, whoſe father ſucceeded to a part of it in 1739 on the death of prince Chriſtian, and to the reſt in 1743 on the death of prince William Hyacynth of Siegen. The prince, on account of this principality alſo and Dietz, has a ſeat and voice in the college of princes, at the diets of the empire and circle. His aſſeſſment in the matricula, for Naſſau-Dillenbourg, is 102 florins monthly; and to the chamber-judicatory, 50 rix-dollars ſix and a half kruitzers, each term. His revenue from this principality is computed at above 130,000 florins.

Nassau-Hadamar, a county of Germany, which, till the year 1711, had princes of its own; but now belongs wholly to William V. prince of Orange.

NASSAU, prince of Orange. See MAURICE.

NATES, in anatomy, a term expreſſing thoſe two fleſhy exterior parts of the body vulgarly called the *buttocks*. See ANATOMY.

Nates Cerebri, are two circular protuberances of the brain, ſituated on the back-ſide of the medulla oblongata, near the cerebellum.

NATION, a collective term, uſed for a conſiderable number of people inhabiting a certain extent of land, confined within fixed limits, and under the ſame government.

NATIONAL DEBT: the money owing by government.

Our limits permit us to give but a very general ſketch of this ſubject: However, as it is of conſiderable importance to every inhabitant of theſe kingdoms, we ſhall endeavour to give as clear and comprehenſive a view of it as the bounds neceſſarily preſcribed us will admit. In order to this, it may not be improper to refer back to the times that have gone before us, that we may the better diſcover the nature of public revenues, the manner of their expenditure, and the cauſes of public debt.

In that rude ſtate of ſociety which precedes the extenſion of commerce and the improvements of manufactures, when thoſe expenſive luxuries which commerce and manufactures can alone introduce, are altogether unknown; the perſon who poſſeſſes a large revenue can ſpend or enjoy that revenue in no other way than by maintaining nearly as many people as it can maintain. Among our feudal anceſtors, the long time during which eſtates uſed to continue in the ſame family, ſufficiently demonſtrates the general diſpoſition of people to live within their income. Though the ruſtic hoſpitality conſtantly exerciſed by the great landholders may not to us in the preſent times ſeem con-

Smith's Wealth of Nations.

National. consiſtent with that order which we are apt to conſider as inſeparably connected with good œconomy, yet we muſt certainly allow them to have been at leaſt ſo far frugal as not commonly to have ſpent their whole income. Some part of this money, perhaps, they ſpent in purchaſing the few objects of vanity and luxury with which the circumſtances of the times could furniſh them; but ſome part of it they ſeem commonly to have hoarded. They could not well indeed do any thing elſe but hoard whatever money they ſaved. To trade was diſgraceful to a gentleman; and to lend money at intereſt, which at that time was conſidered as uſury and prohibited by law, would have been ſtill more ſo.

The ſame diſpoſition to ſave and to hoard prevailed in the ſovereign as well as in the ſubjects. Among nations to whom commerce and manufactures are little known, the ſovereign is in a ſituation which naturally diſpoſes him to the parſimony requiſite for accumulation. In that ſituation the expence even of a ſovereign cannot be directed by that vanity which delights in the gaudy finery of a court. The ignorance of the times affords but few of the trinkets in which that finery conſiſts. Standing armies are not then neceſſary; ſo that the expence even of a ſovereign, like that of any other great lord, can be employed in ſcarce any thing but bounty to his tenants and hoſpitality to his retainers. But bounty and hoſpitality very ſeldom lead to extravagance: though vanity almoſt always does. All the ancient ſovereigns of Europe accordingly had treaſures. Every Tartar chief in the preſent times is ſaid to have one.

In a commercial country abounding with every ſort of expenſive luxury, the ſovereign, in the ſame manner as almoſt all the great proprietors in his dominions, naturally ſpends a great part of his revenue in purchaſing thoſe luxuries. His own and the neighbouring countries ſupply him abundantly with all the coſtly trinkets which compoſe the ſplendid but inſignificant pageantry of a court. His ordinary expence becomes equal to his ordinary revenue, and it is well if it does not frequently exceed it. The amaſſing of treaſure can no longer be expected; and when extraordinary exigencies require extraordinary expences, he muſt neceſſarily call upon his ſubjects for an extraordinary aid. The late king of Pruſſia and his father are the only great princes of Europe who, ſince the death of Henry IV. of France in 1610, are ſuppoſed to have amaſſed any conſiderable treaſure. The parſimony which leads to accumulation has become almoſt as rare in republican as in monarchical governments. The Italian republics, the United Provinces of the Netherlands, are all in debt. The canton of Berne is the ſingle republic in Europe which has amaſſed any conſiderable treaſure. The other Swiſs republics have not. The taſte for ſome ſort of pageantry, for ſplendid buildings at leaſt and other public ornaments, frequently prevails as much in the apparently ſober ſenate-houſe of a little republic as in the diſſipated court of the greateſt king.

The want of parſimony in time of peace impoſes the neceſſity of contracting debt in time of war. When war comes, there is no money in the treaſury but what is neceſſary for carrying on the ordinary expence of the peace eſtabliſhment. In war an eſtabliſhment of three or four times that expence becomes neceſſary for the defence of the ſtate, and conſequently a revenue three or four times greater than the peace revenue. Suppoſing that the ſovereign ſhould have, what he ſcarce ever has, the immediate means of augmenting his revenue in proportion to the augmentation of his expence; yet ſtill the produce of the taxes, from which this increaſe of revenue muſt be drawn, will not begin to come into the treaſury till perhaps ten or twelve months after they are impoſed. But the moment in which war begins, or rather the moment in which it appears likely to begin, the army muſt be augmented, the fleets muſt be fitted out, the garriſoned towns muſt be put into a poſture of defence; that army, that fleet, thoſe garriſoned towns, muſt be furniſhed with arms, ammunition, and proviſions. An immediate and great expence muſt be incurred in that moment of immediate danger, which will not wait for the gradual and ſlow returns of the new taxes. In this exigency government can have no other reſources but in borrowing. National.

The ſame commercial ſtate of ſociety which, by the operation of moral cauſes, brings government in this manner into the neceſſity of borrowing, produces in the ſubjects both an ability and an inclination to lend. If it commonly brings along with it the neceſſity of borrowing, it likewiſe brings along with it the facility of doing ſo.

A country abounding with merchants and manufacturers, neceſſarily abounds with a ſet of people thro' whoſe hands not only their own capitals, but the capitals of all thoſe who either lend them money or truſt them with goods, paſs as frequently or more frequently than the revenue of a private man, who without trade or buſineſs lives upon his income, paſſes through his hands. The revenue of ſuch a man can regularly paſs through his hands only once in a year. But the whole amount of the capital and credit of a merchant who deals in a trade of which the returns are very quick, may ſometimes paſs through his hands two, three, or four times in a year. A country abounding with merchants and manufacturers, therefore, neceſſarily abounds with a ſet of people who have it at all times in their power to advance, if they chooſe to do ſo, a very large ſum of money to government. Hence the ability in the ſubjects of a commercial ſtate to lend.

The progreſs of the enormous debts which at preſent oppreſs, and will in the long run probably ruin, all the great nations of Europe, has been pretty uniform. In England, after the Revolution, when new connections with Europe introduced a new ſyſtem of foreign politics, the expences of the nation, not only in ſettling the new eſtabliſhment, but in maintaining long wars, as principals, on the continent, for the ſecurity of the Dutch barrier, reducing the French monarchy, ſettling the Spaniſh ſucceſſion, ſupporting the houſe of Auſtia, maintaining the liberties of the Germanic body, and other purpoſes, increaſed to an unuſual degree: inſomuch, that it was not thought adviſeable to raiſe all the expences of any one year by taxes to be levied within that year, leſt the unaccuſtomed weight of them ſhould create murmurs among the people. It was therefore the policy of the times to anticipate the revenues of their poſterity, by borrowing immenſe *Blackſt. Comment.*

ſums

National. sums for the current ſervice of the ſtate, and to lay no more taxes upon the ſubject than would ſuffice to pay the annual intereſt of the ſums ſo borrowed; by this means converting the principal debt into a new ſpecies of property, transferable from one man to another at any time and in any quantity. This ſyſtem indeed ſeems to have had its original in the ſtate of Florence, A. D. 1344; which government then owed about L. 60,000 Sterling; and being unable to pay it, formed the principal into an aggregate ſum, called metaphorically a *mount* or *bank*, the ſhares whereof were transferable like our ſtocks, with intereſt at 5 *per cent.* the prices varying according to the exigencies of the ſtate. This laid the foundation of what is called the *national debt*: for a few long annuities created in the reign of Charles II. will hardly deſerve that name.

Nations, like private men, have generally begun to borrow upon what may be called *perſonal credit*, without aſſigning or mortgaging any particular fund for the payment of the debt; and when this reſource has failed them, they have gone on to borrow upon aſſignments or mortgages of particular funds.

What is called the *unfunded debt of Great Britain*, is contracted in the former of thoſe two ways. It conſiſts partly in a debt which bears, or is ſuppoſed to bear, no intereſt, and which reſembles the debts that a private man contracts upon account; and partly in a debt which bears intereſt, and which reſembles what a private man contracts upon his bill or promiſſory note. The debts which are due either for extraordinary ſervices, or for ſervices either not provided for or not paid at the time when they are performed; part of the extraordinaries of the army, navy, and ordnance, the arrears of ſubſidies to foreign princes, thoſe of ſeamens wages, &c. uſually conſtitute a debt of the firſt kind. Navy and exchequer bills, which are iſſued ſometimes in payment of a part of ſuch debts, and ſometimes for other purpoſes, conſtitute a debt of the ſecond kind; exchequer bills bearing intereſt from the day on which they are iſſued, and navy bills ſix months after they are iſſued. The bank of England, either by voluntarily diſcounting thoſe bills at their current value, or by agreeing with government for certain conſiderations to circulate exchequer bills, that is, to receive them at par, paying the intereſt which happens to be due upon them, keeps up their value, and facilitates their circulation, and thereby frequently enables government to contract a very large debt of this kind. During the great recoinage in King William's time, when the bank of England thought proper to put a ſtop to its uſual tranſactions, exchequer bills and tallies are ſaid to have ſold from 25 to 60 *per cent.* diſcount; owing partly, no doubt, to the ſuppoſed inſtability of the new government eſtabliſhed by the Revolution, but partly too to the want of the ſupport of the bank of England.

When this reſource is exhauſted, and it becomes neceſſary, in order to raiſe money, to aſſign or mortgage ſome particular branch of the public revenue for the payment of the debt, government has upon different occaſions done this in two different ways. Sometimes it has made this aſſignment or mortgage for a ſhort period of time only, a year or a few years, for example; and ſometimes for perpetuity. In the one caſe, the fund was ſuppoſed ſufficient to pay within the limited time both principal and intereſt of the money borrowed: In the other, it was ſuppoſed ſufficient to pay the intereſt only, or a perpetual annuity equivalent to the intereſt; government being at liberty to redeem at any time this annuity upon paying back the principal ſum borrowed. When money was raiſed in the one way, it was ſaid to be raiſed *by anticipation;* when in the other, *by perpetual funding*, or, more ſhortly, *by funding*. National.

In the reign of King William, when the debt began to be amaſſed, and during a great part of that of Queen Anne, before we had become ſo familiar as we are now with the practice of perpetual funding, the greater part of the new taxes were impoſed but for a ſhort period of time (for four, five, ſix, or ſeven years only), and a great part of the grants of every year conſiſted in loans upon anticipation of the produce of thoſe taxes. The produce being frequently inſufficient for paying within the limited term the principal and intereſt of the money borrowed, deficiencies aroſe; to make good which it became neceſſary to prolong the term.

On the 31ſt of December 1697, the funded and unfunded debts amounted to L. 21,515,742 : 13 : $8\frac{1}{2}$; at the ſame time, in 1714, they were L. 53,681,076, 5s. $6\frac{1}{12}$d. In 1755, before the breaking out of the war, they amounted to L. 72,289,673; and on the 5th of January 1763, at the concluſion of the peace, they had accumulated to L. 122,603,336 : 8 : $2\frac{1}{4}$ of funded debt, and of unfunded L. 13,027,589 : 2 : 2 more. In 1775, they were very nearly 130 millions; and the laſt American war added upwards of 120 millions more to that enormous ſum: to pay the intereſt of which, and the charges of management, amounting annually to nearly eight millions and an half, the extraordinary revenues elſewhere enumerated † (excepting only the land-tax and annual malt-tax) are in the firſt place mortgaged and made perpetual by parliament. Perpetual we ſay; but ſtill redeemable by the ſame authority that impoſed them: which, if it at any time can pay off the capital, will aboliſh thoſe taxes which are raiſed to diſcharge the intereſt.

† See *Revenue.*

By this means, then, the quantity of property in the kingdom is greatly increaſed in idea compared with former times; yet, if we coolly conſider it, not at all increaſed in reality. We may boaſt of large fortunes, and quantities of money in the funds. But where does this money exiſt? It exiſts only in name, in paper, in public faith, in parliamentary ſecurity: and that is undoubtedly ſufficient for the creditors of the public to rely on. But then what is the pledge which the public faith has pawned for the ſecurity of theſe debts? The land, the trade, and the perſonal induſtry of the ſubject; from which the money muſt ariſe that ſupplies the ſeveral taxes. In theſe therefore, and theſe only, the property of the public creditors does really and intrinſically exiſt; and of courſe the land, the trade, and the perſonal induſtry of individuals, are diminiſhed in their true value juſt ſo much as they are pledged to anſwer. If A's income amounts to L. 100 *per annum;* and he is ſo far indebted to B, that he pays him L. 50 *per annum* for his intereſt; one half of the value of A's property is transferred to B the creditor. The creditor's property exiſts in the demand which he has upon the debtor, and no where elſe; and the debtor is only a truſtee to his creditor for one half

National. of the value of his income. In ſhort, the property of a creditor of the public conſiſts in a certain portion of the national taxes; by how much therefore he is the richer, by ſo much the nation, which pays theſe taxes, is the poorer.

The only advantage that can reſult to a nation from public debts, is the increaſe of circulation, by multiplying the caſh of the kingdom, and creating a new ſpecies of currency, aſſignable at any time and in any quantity; always therefore ready to be employed in any beneficial undertaking, by means of this its tranſferable quality; and yet producing ſome profit even when it lies idle and unemployed. A certain proportion of debt ſeems to be highly uſeful to a trading people; but what that proportion is, it is not for us to determine. This much is indiſputably certain, that the preſent magnitude of our national incumbrances very far exceeds all calculations of commercial benefit, and is productive of the greateſt inconveniences. For, firſt, the enormous taxes that are raiſed upon the neceſſaries of life for the payment of the intereſt of this debt, are a hurt both to trade and manufactures, by raiſing the price as well of the artificer's ſubſiſtence as of the raw material, and of courſe, in a much greater proportion, the price of the commodity itſelf. Nay, the very increaſe of paper-circulation itſelf, when extended beyond what is requiſite for commerce or foreign exchange, has a natural tendency to increaſe the price of proviſions as well as of all other merchandiſe. For as its effect is to multiply the caſh of the kingdom, and this to ſuch an extent that much muſt remain unemployed, that caſh (which is the univerſal meaſure of the reſpective values of all other commodities) muſt neceſſarily ſink in its own value, and every thing grow comparatively dearer. Secondly, if part of this debt be owing to foreigners, either they draw out of the kingdom annually a conſiderable quantity of ſpecie for the intereſt; or elſe it is made an argument to grant them unreaſonable privileges in order to induce them to reſide here. Thirdly, if the whole be owing to ſubjects only, it is then charging the active and induſtrious ſubject, who pays his ſhare of the taxes to maintain the indolent and idle creditor who receives them. Laſtly, and principally, it weakens the internal ſtrength of a ſtate, by anticipating thoſe reſources which ſhould be reſerved to defend it in caſe of neceſſity. The intereſt we now pay for our debts would undoubtedly be ſufficient to maintain the moſt vigorous war that any national motives could poſſibly require. If indeed our anceſtors in King William's time had annually paid, ſo long as their exigencies laſted, a far leſs ſum than we now annually raiſe upon their accounts, they would not in time of war have borne ſo great burdens as they have bequeathed to and ſettled upon their poſterity in time of peace; and might have been eaſed the inſtant the exigence was over. See FUNDS.

On the whole, then, the national debt is undoubtedly a ſubject of vaſt importance, and as ſuch it has been always conſidered; for much has been ſaid and written upon it, and many ſchemes have been propoſed at various times and by various perſons for gradually removing it, it being conſidered by the moſt judicious as a moſt pernicious incumbrance to a commercial country. Some, we are aware, think it of vaſt utility; but this opinion is too eccentric, and in our eſtimation too feebly ſupported, to be convincing. The public debt is indiſputably a great grievance; and every lover of his country muſt ſurely wiſh to ſee it removed: the period, however, when this bleſſing ſhall take place, if indeed it ever arrive, muſt at leaſt be very diſtant. National.

It is neither our buſineſs nor intention (even if the limits preſcribed to the article did not prevent it) to be minute on the ſubject, or to propoſe any ſchemes for alleviating the burdens of the nation. That indeed has been already done by far abler hands than we profeſs to be: we muſt therefore refer ſuch as wiſh for farther information on this intereſting topic to thoſe (and they are not a few) who have treated of it at full length. Smith's Wealth of Nations, and Sir John Sinclair's Hiſtory of the Revenue, go to the bottom of the matter. The writings of Dr Price likewiſe deſerve conſiderable attention, eſpecially as one of his plans for the reduction of the debt has in fact been adopted, and in conſequence eſtabliſhed, by the legiſlature: His three plans may be found in a late pamphlet by William Morgan, intitled, A Review of Dr Price's Writings on the Subject of the Finances of this Kingdom.

NATIVITY, or NATAL DAY, the day of a perſon's birth. The word *nativity* is chiefly uſed in ſpeaking of the ſaints; as, the nativity of St John the Baptiſt, &c. But when we ſay *the* Nativity, it is underſtood of that of Jeſus Chriſt, or the feaſt of Chriſtmas.

NATIVITY, *nativitas*, in ancient law-books, ſignifies bondage or ſervitude.

NATIVITY, in aſtrology, the theme or figure of the heavens, and particularly of the twelve houſes, at the moment when a perſon was born; called alſo the *horoſcope*.

Caſting the nativity, or by calculation ſeeking to know how long the queen ſhould live, &c. was made felony, an. 23 Eliz. c. 2.

NATIVO HABENDO, in law, a writ directed to the ſheriff, for a lord who claimed inheritance in any villain, when a villain was run away from him, for the apprehending and reſtoring him to the lord.

NATIX, in natural hiſtory, a name given by ſome old writers to the *nerita*.

NATOLIA, the modern name of the Leſſer Aſia, being the moſt weſterly part of Turkey in Aſia, and conſiſting of a large peninſula, which extends from the river Euphrates as far as the Archipelago, the ſeas of Marmora, the ſtraits of Galipoli and of Conſtantinople, which ſeparate it from Europe on the weſt. It is bounded on the north by the Black ſea, and on the ſouth by the Mediterranean.

NATRIX, in botany, the name given by Rivinius to a genus of plants nearly allied to the anonis, and comprehended with it in one genus by Linnæus, under the name of anonis. See *Rest-harrow*.

NATRIX, in zoology, the name of the common or water-ſnake, called alſo *torquata*, from the ring about its neck. It is not a water animal, properly ſpeaking, but a land one, which being able to ſwim very well, often takes the water to hunt about for frogs, which are its principal food. It grows to be much longer and larger than the viper, and does not bring forth live young ones, but great numbers of eggs, which it lays in

Natrum || Natural.

dunghills to be hatched by the warmth of the place, or by the heat of the ſun.

NATRUM, the nitre of the ancients, in natural hiſtory, is a genuine, pure, and native ſalt, extremely different from our nitre, and indeed from all the other native ſalts, it being a fixed alkali, plainly of the nature of thoſe made by fire from vegetables, yet capable of a regular cryſtallization, which thoſe ſalts are not. It is found on the ſurface of the earth, or at very ſmall depths within it; and is naturally formed into thin and flat cakes or cruſts, which are of a ſpungy or cavernous ſubſtance, very light and friable, and, when pure, of a pale browniſh white; but as its ſpungy texture renders it very ſubject to be fouled by earth received into its pores, it is often met with of a deep dirty brown, and not unfrequently reddiſh.

Natrum, whether native or purified, diſſolves in a very ſmall quantity of water; and this ſolution is, in many parts of Aſia, uſed for waſhing; where it is alſo made into ſoap, by mixing it with oil. Natrum reduced to powder, and mixed with ſand or flints, or with any other ſtone of which cryſtal is the baſis, make them readily run into glaſs. Gold heated red-hot, and ſprinkled with a ſmall quantity of this ſalt, melts in the ſame manner; as does alſo iron, copper, and the regulus of antimony; which melt much more eaſily than they otherwiſe would do. Mercury cannot be mixed with it by any art, and indeed will not amalgamate with metals if only a little of this ſalt be added. It is found in great abundance in many parts of Aſia, where the natives ſweep it up from the ſurface of the ground, and call it *ſoap-earth*. The earlieſt account we have of it is in the ſcriptures, where we find that the ſalt called *nitre* in thoſe times would ferment with vinegar, and had an abſterſive quality, ſo that it was uſed in baths and in waſhing things. Solomon compares the ſinging of ſongs with a heavy heart, to the contrariety of vinegar and nitre; and Jeremiah ſays, that if the ſinner waſh himſelf with nitre, his ſin is not cleanſed off. Theſe are properties that perfectly agree with this ſalt, but not at all with our ſaltpetre.

NATTER-JACK, in zoology, a ſpecies of RANA.

NATURAL, in general, ſomething that relates to nature. See NATURE.

NATURAL Children, are thoſe born out of lawful wedlock. See BASTARD.

NATURAL Functions, are thoſe actions whereby the aliments are changed and aſſimilated ſo as to become a part of the body.

NATURAL, in heraldry, is uſed where animals, fruits, flowers, &c. are blazoned with the colours they naturally have, though different from the common colours of heraldry: and this is to prevent their armories being accuſed of falſity, when blazoned with the names of colours unknown in heraldry.

NATURAL Note, in muſic, is uſed in oppoſition to flat and ſharp notes, which are called *artificial notes*. See NOTE, SCALE, &c.

NATURAL is alſo uſed for ſomething coming immediately out of the hands of nature: in which ſenſe it ſtands oppoſed to *factitious* or artificial, which ſignifies ſomething wrought by art. See ARTIFICIAL.

Biſhop Wilkins obſerves, that there appears a world of difference between natural and artificial things, when viewed with microſcopes. The firſt ever appear adorned with all imaginable elegance and beauty; the latter, though the moſt curious in their kind, infinitely rude and unhewn: the fineſt needle appears a rough bar of iron; and the moſt accurate engraving or emboſſment, as if done with a mattock or a trowel. Natural.

NATURAL Beauty, or the beauty of natural objects, is that quality or thoſe qualities in the works of nature, or more properly of God, which are calculated to excite pleaſing ſenſations in the minds of all ſuch perſons of true taſte as attentively obſerve them. It will not, we truſt, be deemed improper or impertinent, therefore, to introduce a few obſervations on this ſubject, previous to our treating of natural hiſtory.—To many, it is hoped, it will appear to be a very proper introduction to that important article. "That ſenſibility to beauty, which, when cultivated and improved, we term taſte, is univerſally diffuſed through the human ſpecies†; and it is moſt uniform with reſpect to thoſe objects, which being out of our power are not liable to variation from accident, caprice, or faſhion. The verdant lawn, the ſhady grove, the variegated landſcape, the boundleſs ocean, and the ſtarry firmament, are contemplated with pleaſure by every attentive beholder. But the emotions of different ſpectators, though ſimilar in kind, differ widely in degree; and to reliſh with full delight the enchanting ſcenes of nature, the mind muſt be uncorrupted by avarice, ſenſuality, or ambition; quick in her ſenſibilities; elevated in her ſentiments; and devout in her affections. He who poſſeſſes ſuch exalted powers of perception and enjoyment, may almoſt ſay, with the poet,

† Dr Percival's *Moral and Literary Diſſertations.*

I care not, Fortune! what you me deny;
You cannot rob me of free Nature's grace;
You cannot ſhut the windows of the ſky,
Through which Aurora ſhows her bright'ning face;
You cannot bar my conſtant feet to trace
The woods and lawns, by living ſtream, at eve:
Let health my nerves and finer fibres brace,
And I their toys to the great children leave:
Of fancy, reaſon, virtue, nought can me bereave.

"Perhaps ſuch ardent enthuſiaſm may not be compatible with the neceſſary toils and active offices which Providence has aſſigned to the generality of men. But there are none to whom ſome portion of it may not prove advantageous; and if it were cheriſhed by each individual, in that degree which is conſiſtent with the indiſpenſable duties of his ſtation, the felicity of human life would be conſiderably augmented. From this ſource, the refined and vivid pleaſures of the imagination are almoſt entirely derived: and the elegant arts owe their choiceſt beauties to a taſte for the contemplation of nature. Painting and ſculpture are expreſs imitations of viſible objects; and where would be the charms of poetry, if diveſted of the imagery and embelliſhments which ſhe borrows from rural ſcenes? Painters, ſtatuaries, and poets, therefore, are always ambitious to acknowledge themſelves the pupils of nature; and as their ſkill increaſes, they grow more and more delighted with every view of the animal and vegetable world. But the pleaſure reſulting from admiration is tranſient; and to cultivate taſte, without

Natural. regard to its influence on the paſſions and affection, 'is to rear a tree for its bloſſoms, which is capable of yielding the richeſt and moſt valuable fruit.' Phyſical and moral beauty bear ſo intimate a relation to each other, that they may be conſidered as different gradations in the ſcale of excellence: and the knowledge and reliſh of the former ſhould be deemed only a ſtep to the nobler and more permanent enjoyments of the latter.

"Whoever has viſited the Leaſowes, in Warwickſhire, muſt have felt the force and propriety of an inſcription which meets the eye at the entrance into thoſe delightful grounds.

Would you then taſte the tranquil ſcene?
Be ſure your boſoms be ſerene:
Devoid of hate, devoid of ſtrife,
Devoid of all that poiſons life:
And much it 'vails you, in their place,
To graft the love of human race.

"Now ſuch ſcenes contribute powerfully to inſpire that ſerenity which is neceſſary to enjoy and to heighten their beauties. By a ſecret contagion, the ſoul catches the harmony which ſhe contemplates; and the frame within aſſimilates itſelf to that which is without. For,

Who can forbear to ſmile with Nature? Can
The ſtormy paſſions in the boſom roll,
While every gale is peace, and every grove
Is melody?

"In this ſtate of ſweet compoſure, we become ſuſceptible of virtuous impreſſions, from almoſt every ſurrounding object. The patient ox is viewed with generous complacency; the guileleſs ſheep with pity; and the playful lamb raiſes emotions of tenderneſs and love. We rejoice with the horſe, in his liberty and exemption from toil, while he ranges at large through enamelled paſtures; and the frolics of the colt would afford unmixed delight, did we not recollect the bondage which he is ſoon to undergo. We are charmed with the ſong of birds, ſoothed with the buzz of inſects, and pleaſed with the ſportive motions of fiſhes, becauſe theſe are expreſſions of enjoyment; and we exult in the felicity of the whole animated creation. Thus an equal and extenſive benevolence is called forth into exertion; and having felt a common intereſt in the gratifications of inferior beings, we ſhall be no longer indifferent to their ſufferings, or become wantonly inſtrumental in producing them.

"It ſeems to be the intention of Providence, that the lower order of animals ſhould be ſubſervient to the comfort, convenience, and ſuſtenance of man. But his right of dominion extends no farther; and if this right be exerciſed with mildneſs, humanity, and juſtice, the ſubjects of his power will be no leſs benefited than himſelf. For various ſpecies of living creatures are annually multiplied by human art, improved in their perceptive powers by human culture, and plentifully fed by human induſtry. The relation, therefore, is reciprocal between ſuch animals and man; and he may ſupply his own wants by the uſe of their labour, the produce of their bodies, and even the ſacrifice of their lives, whilſt he co-operates with all-gracious Heaven in promoting happineſs, the great end of exiſtence.

"But though it be true, that partial evil, with reſpect to different orders of ſenſitive beings, may be univerſal good; and that it is a wiſe and benevolent inſtitution of nature, to make deſtruction itſelf, within certain limitations, the cauſe of an increaſe of life and enjoyment; yet a generous perſon will extend his compaſſionate regards to every individual that ſuffers for his ſake: and, whilſt he ſighs Natural.

Even for the kid or lamb that parts its life
Beneath the bloody knife,

he will naturally be ſolicitous to mitigate pain, both in duration and degree, by the gentleſt modes of inflicting it.

"We are inclined to believe, however, that this ſenſe of humanity would ſoon be obliterated, and that the heart would grow callous to every ſoft impreſſion, were it not for the benignant influence of the ſmiling face of nature. The count de Lauzun, when impriſoned by Louis XIV. in the caſtle of Pignerol, amuſed himſelf during a long period of time with catching flies, and delivering them to be devoured by a rapacious ſpider. Such an entertainment was equally ſingular and cruel; and inconſiſtent, we believe, with his former character, and his ſubſequent turn of mind. But his cell had no window, and received only a glimmering light from an aperture in the roof. In leſs unfavourable circumſtances, may we not preſume, that inſtead of ſporting with miſery, he would have releaſed the agoniſing flies, and bid them enjoy that freedom of which he himſelf was bereaved?

"But the taſte for natural beauty is ſubſervient to higher purpoſes than thoſe which have been enumerated: and the cultivation of it not only refines and humaniſes, but dignifies and exalts the affections. It elevates them to the admiration and love of that Being who is the author of all that is fair, ſublime, and good in the creation. Scepticiſm and irreligion are hardly compatible with the ſenſibility of heart which ariſes from a juſt and lively reliſh of the wiſdom, harmony, and order ſubſiſting in the world around us: and emotions of piety muſt ſpring up ſpontaneouſly in the boſom that is in uniſon with all animated nature. Actuated by this divine inſpiration, man finds a fane in every grove; and, glowing with devout fervour, he joins his ſong to the univerſal chorus, or muſes the praiſe of the Almighty, in more expreſſive ſilence. Thus they

Whom Nature's works can charm, with God himſelf
Hold converſe; grow familiar, day by day,
With his conceptions; act upon his plan;
And form to his, the reliſh of their ſouls."

On the whole then, it certainly appears, that the advantages reſulting from a taſte for natural beauties are great and important: it is equally certain, that as it is uſeful, ſo it is a continual ſource of real enjoyment; for a more rational pleaſure cannot poſſibly occupy the attention or captivate the affections of mankind, than that which ariſes from a due conſideration of the works of nature. Pleaſure, we know, is a neceſſary ingredient in human life, in order in ſome meaſure to counterbalance the pains, the evils, and liſtleſsneſſes, which are at times perhaps unavoidable, and in order to render life tolerable. It is the part then of the

Natural. the moraliſt, and it has been frequently his buſineſs, to point out and recommend ſuch pleaſures as are highly gratifying, and are yet perfectly innocent. The Spectator, whoſe works will be admired as long as the language in which they are written is underſtood, recommends ſtrongly and elegantly the pleaſure of a gar-
Dr Knox. den; and a later writer, of no common degree of merit, and of very conſiderable fame, has an eſſay on the ſame ſubject, from which we ſhall ſelect a few obſervations, and ſo conclude the article. "Not he alone (ſays this elegant writer) is to be eſteemed a benefactor to mankind, who makes an uſeful diſcovery; but he alſo who can point out and recommend an innocent pleaſure. Of this kind are the pleaſures ariſing from the obſervation of nature; and they are highly agreeable to every taſte uncorrupted by vicious indulgence. Rural ſcenes of almoſt every kind are delightful to the mind of man. But the misfortune is, that the greater part are hurried on in the career of life with too great rapidity to be able to give attention to that which ſolicits no paſſion. The darkeſt habitation in the dirtieſt ſtreet of the metropolis, where money can be earned, has greater charms with many than the groves of Hagley.

"The patron of refined pleaſure, the elegant Epicurus, fixed the ſeat of his enjoyment in a garden. He was of opinion, that a tranquil ſpot, furniſhed with the united ſweets of art and nature, was the beſt adapted to delicate repoſe. And even the ſeverer philoſophers of antiquity were wont to diſcourſe in the ſhade of a ſpreading tree, in ſome cultivated plantation. It is obvious, on intuition, that nature often intended ſolely to pleaſe the eye in her vegetable productions. She decorates the flowret that ſprings beneath our feet in all the perfections of external beauty. She has clothed the garden with a conſtant ſucceſſion of various hues. Even the leaves of the tree undergo a pleaſing viciſſitude. The freſh verdure which they exhibit in the ſpring, the various ſhades which they aſſume in ſummer, the yellow and ruſſet tinge of autumn, and the nakedneſs of winter, afford a conſtant pleaſure to a lively imagination. From the ſnow-drop to the moſs-roſe, the flower garden diſplays an infinite variety of ſhape and colour. The taſte of the floriſt has been ridiculed as trifling; yet ſurely without reaſon. Did nature bring forth the tulip and the lily, the roſe and the honeyſuckle, to be neglected by the haughty pretender to ſuperior reaſon? To omit a ſingle ſocial duty for the cultivation of a polyanthus were ridiculous as well as criminal; but to paſs by the beauties laviſhed before us, without obſerving them, is no leſs ingratitude than ſtupidity. A bad heart finds little amuſement but in a communication with the active world, where ſcope is given for the indulgence of malignant paſſions; but an amiable diſpoſition is commonly known by a taſte for the beauties of the animal and the vegetable creation." In ſhort, ſince the world was made for our uſe, ſince the beauties of nature are alike diſplayed before all men, and ſince they are unqueſtionably an inexhauſtible fund of innocent amuſement; that ſubject muſt be of vaſt importance which enables us to reliſh them properly. Natural.

NATURAL HISTORY.

NATURAL HISTORY, in its moſt extenſive ſignification, denotes a knowledge and deſcription of the whole univerſe. Matters of fact reſpecting the heavens, meteors, the atmoſphere, the earth, reſpecting all the phenomena, indeed, which occur in the world, and even of the external parts and actions of man himſelf, as far as reaſon can diſcover them, belong to the province of natural hiſtory; but when we leave the ſimple recital of effects, and endeavour to inveſtigate the cauſes of ſuch and ſuch phenomena, we then leave natural hiſtory, and enter on philoſophy. The object of our article, therefore, in the ſenſe we have here given it, is as extenſive as nature itſelf. But, in its more appropriated ſenſe, it is well known that its province only extends to the ſurface of the earth, the works on it, and the inhabitants of it. It treats of thoſe ſubſtances of which, as far as our reſearches have led us, the earth is compoſed, and of thoſe organized bodies, whether vegetable or animal, which adorn its ſurface, which riſe into the air, or live in the boſom of the waters.—But as a ſcience ſo various and comprehenſive could neither with propriety nor advantage be completely diſcuſſed under the general title, we have to refer the reader to the article KINGDOMS *(in Natural Hiſtory)*, where he will be directed to the different articles which conſtitute either the branches or the objects of the ſcience, and which are all treated under their reſpective names. In the preſent article it is propoſed to give a general and philoſophical view of the ſubject: To ſet forth, in a ſummary way, whatever curious, worthy to be known, or not obvious to every obſerver, occurs in the three kingdoms of nature: with their conſtitution, laws, and œconomy; or, in other words, that all-wiſe diſpoſition of the Creator in relation to natural things, by which they are fitted to produce general ends and reciprocal uſes.

SECT. I. *Of the Terraqueous Globe in general, and its changes.*

THE world, or the terraqueous globe, which we inhabit, is every-where ſurrounded with elements, and contains in its ſuperficies the three KINGDOMS *of Nature*, as they are called: the foſſil, which conſtitutes the cruſt of the earth; the vegetable, which adorns the face of it, and draws the greateſt part of its nouriſhment from the foſſil kingdom; and the animal, which is ſuſtained by the vegetable kingdom. Thus, then, theſe three grand diviſions, or, as they are commonly called, kingdoms; cover, adorn, and vary, the ſurface of the earth.

As to the STRATA of the EARTH and MOUNTAINS, as far as we have hitherto been able to diſcover, the upper parts conſiſt of rag-ſtone; the next of ſlate; the third of marble filled with petrifactions; the fourth again, of ſlate; and laſtly, the loweſt of free ſtone.—

Of the Terraqueous Globe.

The habitable part of the earth, though it is ſcooped into various inequalities, yet is every-where high in compariſon with the water; and the farther it is from the ſea it is generally higher. Thus the waters in the lower places are not at reſt, unleſs ſome obſtacle confines them, and by that means form lakes and marſhes.

The SEA ſurrounds the continent, and takes up the greateſt part of the earth's ſurface, as geographers inform us. Nay, that it once ſpread over much the greateſt part, we may be convinced by its yearly decreaſe, by the rubbiſh left by the tides, by ſhells, ſtrata, and other circumſtances.

The ſea-ſhores are uſually full of dead teſtaceous animals, wreck, and ſuch like bodies, which are yearly thrown out of the ſea. They are alſo covered with ſand of various kinds, ſtones, &c. It happens, moreover, that while the more rapid rivers ruſh through narrow valleys, they wear away the ſides; and thus the friable and ſoft earth falls in, and its ruins are carried to diſtant and winding ſhores; whence it is certain, that the continent gains no ſmall increaſe, as the ſea ſubſides.

The CLOUDS collected from exhalations, chiefly from the ſea, but likewiſe from other waters, and moiſt grounds, and condenſed in the lower regions of the ATMOSPHERE, ſupply the earth with RAIN; but ſince they are attracted by the mountainous parts of the earth, it neceſſarily follows, that thoſe parts muſt have, as is fit, a larger ſhare of water than the reſt. SPRINGS, which generally ruſh out at the foot of mountains, take their riſe from this very rain-water, and vapours condenſed, that trickle through the holes and interſtices of looſe bodies, and are received into caverns.

Theſe afford a pure WATER purged by ſtraining; and rarely dry up in ſummer, or freeze in winter, ſo that animals never want a wholeſome and refreſhing liquor.

The chief ſources of RIVERS are fountains and rills growing by gradual ſupplies into ſtill larger and larger ſtreams; till at laſt, after the conflux of a vaſt number of them, they find no ſtop, but falling into the ſea with much rapidity, they there depoſit the united ſtores they have gathered, along with foreign matter, and ſuch earthy ſubſtances as they tore off in their way. Thus the water returns in a circle whence it firſt drew its origin, that it may act over the ſame ſcene in continued ſucceſſion.

Marſhes ariſing from water retained in low grounds, are filled with moſſy tumps, which are brought down by the water from the higher parts, or are produced by putrified plants.

We often ſee new meadows ariſe from marſhes dried up. This happens ſooner when the *ſphagnum* (a kind of moſs) has laid a foundation; for this in proceſs of time changes into a very porous mould, till almoſt the whole marſh is filled with it. After that the ruſh ſtrikes root, and along with the cotton-graſſes conſtitutes a turf, raiſed in ſuch a manner that the roots get continually higher, and thus lay a more firm foundation for other plants, till the whole marſh is changed into a fine and delightful meadow; eſpecially if the water happens to work itſelf a new paſſage.

Hillocks, that abound in low grounds, occaſion the earth to increaſe yearly, more than the countryman would wiſh, and ſeem to do hurt: but in this the great induſtry of nature deſerves to be taken notice of. For by this means the barren ſpots become ſooner rich meadow and paſture-land. Theſe hillocks are formed by the ant, by ſtones and roots, and the trampling of cattle: but the principal cauſe is the force of the winter-cold, which in the ſpring raiſes the roots of plants ſo high above the ground, that being expoſed to the air, they grow, and periſh; after which the golden maidenhairs fill the vacant places.

Mountains, hills, valleys, and all the inequalities of the earth, though ſome think they take away much from its beauty, are ſo far from producing ſuch an effect, that on the contrary they give a more pleaſing aſpect, and confer great advantages. For thus the terreſtrial ſuperficies is larger; different kinds of plants thrive better, and are more eaſily watered; and the rain-waters run in continual ſtreams into the ſea; not to mention many other uſes in relation to winds, heat, and cold. Alps are the higheſt mountains, that reach to the ſecond region of the air, where trees cannot grow erect. The higher theſe Alps are, the colder they are *cæteris paribus*. Hence the Alps in Sweden, Siberia, Swiſſerland, Peru, Braſil, Armenia, Aſia, Africa, are perpetually covered with ſnow, which becomes almoſt as hard as ice. But if by chance the ſummer heats be greater than ordinary, ſome part of theſe ſtores melts, and runs through rivers into the lower regions, which by this means are much refreſhed.

It is ſcarcely to be doubted, but that the rocks and ſtones diſperſed over the globe were formed originally in, and from, the earth; but when torrents of rain have ſoftened, as they eaſily do, the ſoluble earth, and carried it down into the lower parts, we imagine it happens, that theſe ſolid and heavy bodies, being laid bare, ſtick out above the ſurface. We might alſo take notice of the wonderful effect of the tide, ſuch as we ſee happen from time to time on the ſea-ſhore, which being daily and nightly aſſaulted with repeated blows, at length gives way, and breaks off. Hence we ſee in moſt places the rubbiſh of the ſea, and ſhores.

The winter by its froſt prepares the earth and mould, which thence are broken into very minute particles, and thus, being put into a mouldering ſtate, become more fit for the nouriſhment of plants; nay, by its ſnow it covers the ſeeds and roots of plants, and thus by *cold* defends them from the *force of cold*. We muſt add alſo, that the piercing froſt of the winter purifies the atmoſphere and putrid waters, and makes them more wholeſome for animals.

The perpetual ſucceſſion of heat and cold with us renders the ſummers more pleaſing: and tho' the winter deprives us of many plants and animals, yet the perpetual ſummer within the tropics is not much more agreeable, as it often deſtroys men and other animals by its immoderate heat; though it muſt be confeſſed, that thoſe regions abound with exquiſite fruits. Our winters though very troubleſome to a great part of the globe on account of their vehement and intenſe cold, yet are leſs hurtful to the inhabitants of the northern parts, as experience teſtifies. Hence it happens,

Of the Terraqueous Globe.

Of the Seaſons.

pens, that we may live very conveniently on every part of the earth, as every different country has different advantages from nature.

The ſeaſons, like every thing elſe, have their viciſſitudes; their beginnings, their progreſs, and their end.

The age of man begins from the cradle; pleaſing childhood ſucceeds; then active youth; afterwards manhood, firm, ſevere, and intent upon ſelf-preſervation; laſtly, old age creeps on, debilitates, and at length totally deſtroys our tottering bodies.

The ſeaſons of the year proceed in the ſame way. Spring, the jovial, playful infancy of all living creatures, repreſents childhood and youth; for then plants ſpread forth their luxuriant flowers, fiſhes exult, birds ſing, every part of nature is intent upon generation. The ſummer, like middle age, exhibits plants, and trees every where cloathed with green; it gives vigour to animals, and plumps them up; fruits then ripen, meadows look cheerful, every thing is full of life. On the contrary, autumn is gloomy; for then the leaves of trees begin to fall, plants to wither, inſects to grow torpid, and many animals to retire to their winter-quarters.

The day proceeds with juſt ſuch ſteps as the year. The morning makes every thing alert, and fit for buſineſs: the ſun pours forth his ruddy rays; the flowers, which had as it were ſlept all night, awake and expand themſelves again; the birds with their ſonorous voices and various notes make the woods ring, meet together in flocks, and ſacrifice to Venus. Noon tempts animals into the fields and paſtures; the heat puts them upon indulging their eaſe, and even neceſſity obliges them to it. Evening follows, and makes every thing more ſluggiſh; flowers ſhut up *, and animals retire to their lurking places. Thus the ſpring, the morning, and youth, are proper for generation; the ſummer, noon, and manhood, are proper for preſervation; and autumn, evening, and old age, are not unfitly likened to deſtruction.

* See VIGILS *of Plants.*

In order to perpetuate the eſtabliſhed courſe of nature in a continued ſeries, the Divine Wiſdom has thought fit that all living creatures ſhould conſtantly be employed in *producing* individuals; that all natural things ſhould contribute and lend a helping hand towards *preſerving* every ſpecies; and laſtly, that the *death* and *deſtruction* of one thing ſhould always be ſubſervient to the production of another. Hence the objects of our preſent inquiry fall to be conſidered in a threefold view, that of *propagation*, *preſervation*, and *death* or *deſtruction*.

Sect. II. *The Foſſil Kingdom.*

I. Propagation.

It is agreed on all hands, that ſtones are not organical bodies, like plants and animals; and therefore it is as clear that they are not produced from an egg, like the tribes of the other kingdoms. Hence the variety of foſſils is proportionate to the different combinations of coaleſcent particles; and hence the ſpecies in the foſſil kingdom are not ſo diſtinct as in the other two. Hence alſo the laws of generation in

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relation to foſſils have been in all ages extremely difficult to explain; and laſtly, hence have ariſen ſo many different opinions about them, that it would be endleſs to enumerate them all. We therefore, for the preſent, ſhall content ourſelves with giving a very few obſervations on this ſubject.

Some people ſuppoſe that clay is the ſediment of the ſea; and obſervation ſo far ſeems to go along with this opinion, for great plenty of it is generally found along the coaſts. Seamen who have been ſo accurate as to keep journals, have obſerved, that a very minute ſand covers the bottom of the ocean; and ſeem to think that it is daily cryſtallized from the water. It is now generally acknowledged, that teſtaceous bodies and petrifactions reſembling animals were once real animals or vegetables. It has been ſuppoſed indeed, that ſhells, being of a calcareous nature, changed the adjacent clay, ſand, or mould, into the ſame kind of ſubſtance. Hence it appears certain, that marbles may be generated from petrifactions; and therefore it is often full of them. Rag-ſtone, the common matter of our rocks, appears to be formed from a ſandy kind of clay; moſt frequently, however, this appears to happen where the earth is impregnated with iron. Free-ſtone ſeems to be the product of ſand; and the deeper the bed where it is found, the more compact it becomes; and the more denſe the ſand, the more eaſily it concretes. But if an alkaline clay chances to be mixed with the ſand, the freeſtone is generated more readily, as in that called *cos friatilis particulis argillo-glarenſis*. The flint is almoſt the only kind of ſtone, certainly the moſt common, in chalky mountains.—It would appear therefore from this to be produced from chalk: but whether it can be reduced to chalk again, is left for others to enquire.

Stalactites, or drop-ſtone, is compoſed f calcareous particles, adhering to a dry, and generally a vegetable body, and is depoſited by dropping water; from which circumſtance it ſeems to have derived its vulgar name.

Incruſtations (Syſt. Nat. 32. 5. 6. 7. 8.) are, in general, it appears, generated where a vitriolic water connects clayey and earthy particles together.

Slate, by the vegetables that are often incloſed in it, ſeems to take its origin from a marſhy mould.

Metals vary according to the nature of the matrix in which they adhere; *e. g.* the pyrites cupri Fahlumenus contains frequently ſulphur, arſenic, iron, copper, a little gold, vitriol, alum, ſometimes lead-ore, ſilver, and zinc. Thus gold, copper, iron, zinc, arſenic, pyrites, vitriol, come out of the ſame vein. That very rich iron-ore at Normark in Vermilandia, where it was cut tranſverſely by a vein of clay, was changed into pure ſilver. The number therefore of ſpecies and varieties of foſſils, each ſerving for different purpoſes according to their different natures, will be in proportion as the different kinds of earths and ſtones are variouſly combined.

II. Preservation.

As foſſils are deſtitute of life and organization, are hard, and not obnoxious to putrefaction; ſo they laſt longer than any other kind of bodies. How far the air contributes to this duration, it is eaſy to perceive; ſince air hardens many ſtones upon the ſurface

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face of the earth, and makes them more solid, compact, and able to resist the injuries of time. Thus it is known from vulgar observation, that lime that has been long exposed to the air becomes hardened. The chalky marl which they use in Flanders and about Bath for building houses, as long as it continues in the quarry is friable; but when dug up and exposed to the air it grows gradually harder.

However ignorant we may be of the cause why large rocks are every-where to be seen split, whence vast fragments are frequently torn off; yet we may observe, that fissures are closed up by water, which gets between them, and is detained there; forming crystal and spar. Hence we scarcely ever find any crystal, but in those stones which have retained for some time in its chinks, water loaded with stony particles. In the same manner crystal fills the cavities in mines, and concrete into quartz or a debased crystal.

It is manifest that stones are not only generated, augmented, and changed perpetually, from incrustations brought upon moss, but are also increased by crystal and spar. Not to mention that the adjacent earth, especially if it be impregnated with iron particles, is commonly changed into a solid stone.

It is said, that the marble quarries in Italy, from whence fragments are cut, grow up again. Ores grow by little and little, whenever the mineral particles, conveyed by the means of water through the clefts of mountains, are retained there; so that, adhering to the homogeneous matter a long while, at last they take its nature, and are changed into a similar substance.

III. Destruction.

Fossils, although they are the hardest of bodies, yet are found subject to the laws of destruction, as well as all other created substances. For they are dissolved in various ways by the elements exerting their force upon them; as by water, air, and the solar rays; as also by the rapidity of rivers, violence of cataracts, and eddies, which continually beat upon, and at last reduce to powder the hardest rocks. The agitations of the sea, and lakes, and the vehemence of the waves, excited by turbulent winds, pulverise stones, as evidently appears by their roundness along the shore. Nay, as the poet says,

> The hardest stone insensibly gives way
> To the soft drops that frequent on it play.

So that we ought not to wonder that these very hard bodies moulder away into powder, and are obnoxious like others to the consuming tooth of time.

Sand is formed of free-stone, which is destroyed partly by frost, making it friable; partly by the agitation of water and waves, which easily wear away, dissolve, and reduce into minute particles what the frost had made friable.

Chalk is in general supposed to be formed of rough marble, which the air, the sun, and the winds have dissolved. The slate earth, or humus schisti, (Syst. Nat. 512.) owes its origin to slate, showers, air, and snow melted.

Ochre is formed of metals dissolved, and presents the very same colours which we always find the ore tinged with when exposed to the air. Vitriol in the same manner mixes with water from ore destroyed.

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The muria saxatilis (Syst. Nat. 14. 6), a kind of talky stone, yielding salt in the parts that are turned to the sun, is dissolved into sand, which falls by little and little upon the earth till the whole is consumed; not to mention other kinds of fossils. Lastly, from these there arise new fossils, as we mentioned before; so that the destruction of one thing serves for the generation of another.

Testaceous worms ought not to be passed over on this occasion, for they eat away the hardest rocks. That species of shell fish called the *razor-shell* bores through stones in Italy, and hides itself within them; so that the people who eat them are obliged to break the stones before they can come at them. The cochlea, (*Faun. Suec.* 1299.) a kind of snail that lives on craggy rocks, eats and bores through the chalky hills, as worms do through wood. This is made evident by the observations of the celebrated de Geer.

It ought to be observed here, that there are often found dead insects in the hearts of the hardest rocks, without any visible trace of the manner of their getting there; from whence many have supposed that stones were originally fluid. Concerning such matters, about which we have but little data, there will always be a great diversity of opinions. It is not our business, at least in this place, to give an opinion on a doubtful subject: the fact is so; of the cause let others judge.

Sect. III. *The Vegetable Kingdom.*

1. Propagation.

Anatomy abundantly proves, that all plants are organic and living bodies; and that all organic bodies are propagated from an egg has been sufficiently demonstrated by the industry of modern writers. We therefore the rather, according to the opinion of the skilful, reject the equivocal generation of plants; and the more so, as it is certain that every living thing is produced from an egg. Now the seeds of vegetables are called *eggs*; these are different in every different plant, that the means being the same, each may multiply its species, and produce an offspring like its parent. We do not deny, that very many plants push forth from their roots fresh offsets for two or more years. Nay, not a few plants may be propagated by branches, buds, suckers, and leaves, fixed in the ground, as likewise many trees. Hence their stems being divided into branches, may be looked on as roots above ground; for in the same way the roots creep under ground, and divide into branches. And there is the more reason for thinking so, because we know that a tree will grow in an inverted situation, *viz.* the roots being placed upwards, and the head downwards, and buried in the ground; for then the branches will become roots, and the roots will produce leaves and flowers. The lime-tree will serve for an example, on which gardeners have chiefly made an experiment. Yet this by no means overturns the doctrine, that all vegetables are propagated by seeds; since it is clear, that in each of the foregoing instances nothing vegetates but what was

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was the part of a plant, formerly produced from ſeed; ſo that, accurately ſpeaking, without ſeed no new plant is produced.

Thus again plants produce ſeeds; but they are entirely unfit for propagation, unleſs fecundation precedes, which is performed by an intercourſe between different ſexes, as experience teſtifies. Plants therefore muſt be provided with organs of generation; in which reſpect they are analogous to animals.—Since in every plant the flower always precedes the fruit, and the fecundated ſeeds viſibly ariſe from the fruit; it is evident that the organs of generation are contained in the flower, which organs are called *antheræ* and *ſtigmata*, and that the impregnation is accompliſhed within the flower. This impregnation is performed by means of the duſt of the antheræ falling upon the moiſt ſtigmata, where the duſt adheres, is burſt, and ſends forth a very ſubtle matter, which is abſorbed by the ſtyle, and is conveyed down to the rudiments of the ſeed, and thus renders it fertile. When this operation is over, the organs of generation wither and fall, nay a change in the whole flower enſues. We muſt, however, obſerve, that in the vegetable kingdom one and the ſame flower does not always contain the organs of generation of both ſexes, but oftentimes the male organs are on one plant and the female on another. But that the buſineſs of impregnation may go on ſucceſsfully, and that no plant may be deprived of the neceſſary duſt, the whole moſt elegant apparatus of the antheræ and ſtigmata in every flower is contrived with wonderful wiſdom.

For in moſt flowers the ſtamina ſurround the piſtils, and are of about the ſame height: but there are many plants in which the piſtil is longer than the ſtamina; and in theſe it is wonderful to obſerve, that the Creator has made the flowers recline, in order that the duſt may the more eaſily fall into the ſtigma, *e g.* in the campanula, cowſlip, &c. This curious phenomenon did not eſcape the poetical eye of Milton, who deſcribes it in the following enlivened imagery:

With cowſlips wan, that hang the penſive head.

But when the fecundation is completed, the flowers riſe again, that the ripe ſeeds may not fall out before they are diſperſed by the winds. In other flowers, on the contrary, the piſtil is ſhorter, and there the flowers preſerve an erect ſituation; nay, when the flowering comes on, they become erect, though before they were drooping, or immerſed under water. Laſtly, whenever the male flowers are placed below the female ones, the leaves are exceedingly ſmall and narrow, that they may not hinder the duſt from flying upwards like ſmoke; as we ſee in the pine, fir, yew, ſea-grape, juniper, cypreſs, &c. And when in one and the ſame ſpecies one plant is male and the other female, and conſequently may be far from one another, there the duſt, without which there is no impregnation, is carried in abundance by the help of the wind from the male to the female; as in the whole dicœcious claſs. Again, a more difficult impregnation is compenſated by the longevity of the individuals, and the continuation of life by buds, ſuckers, and roots; ſo that we may obſerve every thing moſt wiſely diſpoſed in this affair. Moreover, we cannot without admiration obſerve, that moſt flowers expand themſelves when the ſun ſhines forth; whereas when clouds, rain, or the evening comes on, they cloſe up, leſt the genital duſt ſhould be coagulated or rendered uſeleſs, ſo that it cannot be conveyed to the ſtigmata. But what is ſtill more remarkable and wonderful, when the fecundation is over, the flowers, neither in rain nor on the approach of night cloſe themſelves up. Hence when rain falls in the flowering time, the huſbandman and gardener foretel a ſcarcity of fruits. To mention only one particular more: The organs of generation, which in the animal kingdom are by nature generally removed from ſight, in the vegetable are expoſed to the eyes of all; and that when their nuptials are celebrated, it is wonderful what delight they afford to the ſpectator by their moſt beautiful colours and delicious odours. At this time bees, flies, and other inſects, ſuck honey out of their nectaries, not to mention the humming bird; and that from their effete duſt the bees gather wax. All the experiments that have hitherto been made ſeem to confirm the hypotheſis above unfolded; although it has lately been controverted by the author of the *Philoſophy of Natural Hiſtory*.

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Vit. a treatiſe publiſhed in *Amœn. Acad.* vol. i. intitled *Sponſalia Plantarum*.

As to the diſſemination of ſeeds after they come to maturity, it being abſolutely neceſſary, ſince without it no crop could follow, the Author of nature has wiſely provided for this affair in numberleſs ways. The ſtalks and ſtems favour this purpoſe; for theſe raiſe the fruit above the ground, that the winds, ſhaking them to and fro, may diſperſe far off the ripe ſeeds. Moſt of the pericarpies are ſhut at top, that the ſeeds may not fall before they are ſhaken out by ſtormy winds. Wings are given to many ſeeds, by the help of which they fly far from the mother-plant, and oftentimes ſpread over a whole country. Theſe wings conſiſt either of a down, as in moſt of the compoſite-flowered plants; or of a membrane, as in the birch, alder, aſh, &c. Hence woods, which happen to be conſumed by fire or any other accident, will ſoon be reſtored again by new plants diſſeminated by this means. Many kinds of fruits are endued with a remarkable elaſticity, by the force of which the ripe pericarpies throw the ſeeds to a great diſtance; as the wood-ſorrel, the ſpurge, the phyllanthus, the dittany. Other ſeeds or pericarpies are rough, or provided with hooks; ſo that they are apt to ſtick to animals that paſs by them, and by this means are carried to their holes, where they are both ſown and manured by nature's wonderful care: and therefore the plants of theſe ſeeds grow where others will not; as hounds-tongue, agrimony, &c.

Berries and other pericarpies are by nature allotted for aliment to animals; but with this condition, that while they eat the pulp they ſhall ſow the ſeeds: for when they feed upon it, they either diſperſe them at the ſame time; or, if they ſwallow them, they are returned with intereſt, for they always come out unhurt. It is not therefore ſurpriſing, that, if a field be manured with recent mud or dung not quite rotten, various other plants, injurious to the farmer, ſhould come up along with the grain that is ſowed. Many have believed that barley or rye has been changed into oats, although all ſuch kinds of metamorphoſes are repugnant to the laws of generation; not conſidering, that there is another cauſe of this phenomenon, *viz.* that the ground perhaps has been manured with horſe-dung, in which the ſeeds of oats, coming entire from the

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horſe, lie hid and produce that grain. The miſletoe always grows upon other trees, becauſe the thruſh that eats the ſeeds of it, caſts them forth with its dung; and as bird-catchers make their bird-lime of this ſame plant, and daub the branches of trees with it, in order to catch the thruſh, the proverb hence took its riſe:

The thruſh, when he befouls the bough,
Sows for himſelf the ſeeds of wo.

It is not to be doubted, but that the greateſt part of the junipers alſo, that fill our woods, are ſown by thruſhes, and other birds, in the ſame manner; as the berries, being heavy, cannot be diſperſed far by the winds. The croſs-bill that lives on the fir-cones, and the hawfinch that feeds on the pine-cones, at the ſame time ſow many of their ſeeds; eſpecially when they carry the cone to a ſtone, or trunk of a tree, that they may more eaſily ſtrip it of its ſcales. Swine likewiſe, by turning up the earth, and moles by throwing up hillocks, prepare the ground for ſeeds in the ſame manner as the ploughman does.

We paſs over many other things which might be mentioned concerning the ſea, lakes, and rivers, by the help of which oftentimes ſeeds are conveyed unhurt to diſtant countries. A variety of other ways in which nature provides for the diſſemination of plants, has been pointed out by Linnæus in an *Oration concerning the augmentation of the habitable earth*. As there is ſomething very ingenious and quite new in the treatiſe here referred to, we ſhall, for the ſake of thoſe who cannot read the original, add a ſhort abſtract of it. His deſign is to ſhow, that there was only one pair of all living things, created at the beginning. According to the account of Moſes, ſays the author, we are ſure that this was the caſe in the human ſpecies; and by the ſame account we are informed that this firſt pair was placed in Eden, and that Adam gave names to all the animals. In order therefore that Adam might be enabled to do this, it was neceſſary that all the ſpecies of animals ſhould be in paradiſe; which could not happen unleſs alſo all the ſpecies of vegetables had been there likewiſe. This he proves from the nature of their food; particularly in relation to inſects, moſt of which live upon one plant only. Now had the world been formed in its preſent ſtate, it could not have happened that all the ſpecies of animals ſhould have been there. They muſt have been diſperſed over all the globe, as we find they are at preſent; which he thinks improbable for other reaſons which we ſhall paſs over for ſake of brevity. To ſolve all the phenomena, then, he lays down as a principle, That at the beginning all the earth was covered with the ſea, unleſs one iſland large enough to contain all animals and vegetables. This principle he endeavours to eſtabliſh by ſeveral phenomena, which makes it probable that the earth has been and is ſtill gaining upon the ſea, and does not forget to mention foſſil ſhells and plants every where found, which he ſays cannot be accounted for by the deluge. He then undertakes to ſhow how all vegetables and animals might in this iſland have a ſoil and climate proper for each, only by ſuppoſing it to be placed under the equator, and crowned with a very high mountain. For it is well known that the ſame plants are found on the Swiſs, the Pyrenean, the Scots Alps, on Olympus, Lebanon, Ida, as on the Lapland and Greenland Alps. And Tournefort found at the bottom of mount Ararat the common plants of Armenia, a little way up thoſe of Italy, higher thoſe which grow about Paris, afterwards the Swediſh plants, and laſtly on the top the Lapland Alpine plants; and I myſelf, adds the author, from the plants growing on the Dalecarlian Alps could collect how much lower they were than the Alps of Lapland. He then proceeds to ſhow how from one plant of each ſpecies the immenſe number of individuals now exiſting might ariſe. He gives ſome inſtances of the ſurpriſing fertility of certain plants; *v. g.* the elecampane, one plant of which produced 3000 ſeeds; of ſpelt, 2000; of the ſun-flower, 4000; of the poppy. 3200; of tobacco, 40,320. But ſuppoſing any annual plant producing yearly only two ſeeds, even of this, after 20 years, there would be 1,048,576 individuals. For they would increaſe yearly in a duple proportion, *viz.* 2, 4, 8, 16, 32, &c. He then gives ſome inſtances of plants brought from America, that are now become common over many parts of Europe. Laſtly, he enters upon a detail of the ſeveral methods which nature has taken to propagate vegetables, which is extremely curious, but too long to inſert in this place.

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II. Preservation.

1. The great Author and Parent of all things decreed, that the whole earth ſhould be covered with plants, and that no place ſhould be void, none barren. But ſince all countries have not the ſame changes of ſeaſons, and every ſoil is not equally fit for every plant; he therefore, that no place ſhould be without ſome, gave to every one of them ſuch a nature, as might be chiefly adapted to the climate: ſo that ſome of them can bear an intenſe cold, others an equal degree of heat; ſome delight in dry ground, others in moiſt, &c. Hence the ſame plants grow only where there are the ſame ſeaſons of the year, and the ſame ſoil.

The Alpine plants live only in high and cold ſituations; and therefore often on the Alps of Armenia, Switzerland, the Pyreneans, &c. whoſe tops are equally covered with eternal ſnows as thoſe of the Lapland Alps, plants of the ſame kind are found, and it would be in vain to ſeek for them any where elſe. It is remarkable, in relation to the Alpine plants, that they blow, and ripen their ſeeds very early, leſt the winter, ſhould ſteal upon them on a ſudden, and deſtroy them.

Our northern plants, although they are extremely rare everywhere elſe, yet are found in Siberia, and about Hudſon's Bay; as the arbutus, bramble, wintergreen, &c.

Plants impatient of cold live within the torrid zones; hence both the Indies, though at ſuch a diſtance from one another, have plants in common. The Cape of Good Hope, we know not from what cauſe, produces plants peculiar to itſelf; as all the meſembryanthema, and almoſt all the ſpecies of aloes. Graſſes, the moſt common of all plants, can bear almoſt any temperature of air: in which the good providence of the Creator particularly appears; for all over the globe, they above all plants are neceſſary for the nouriſhment of cattle; and the ſame thing is ſeen in relation to our moſt common grains.

Thus neither the ſcorching ſun, nor the pinching cold, hinders any country from having its vegetables.

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Nor is there any ſoil which does not bring forth many kinds of plants. The pond-weeds, the water-lily, lobelia, inhabit the waters. The fluviales, fuci, conſervæ, cover the bottoms of rivers, and ſea. The ſphagna * fill the marſhes. The brya† clothe the plains. The drieſt woods, and places ſcarce ever illumihated by the rays of the ſun, are adorned with the hypna. Nay, ſtones and the trunks of trees are not excepted, for theſe are covered with various kinds of liverwort.

* A kind of moſs.
† Another kind of moſs.

The deſart and moſt ſandy places have their peculiar trees and plants; and as rivers or brooks are very ſeldom found there, we cannot without wonder obſerve that many of them diſtil water, and by that means afford the greateſt comfort both to man and beaſt that travel there. Thus the tillandſia‡, which is a paraſitical plant, and grows on the tops of trees in the deſarts of America, has its leaves turned at the baſe into the ſhape of a pitcher, with the extremity expanded; in theſe the rain is collected, and preſerved for thirſty men, birds, and beaſts.

‡ A kind of miſletoe.

The water-tree in Ceylon produces cylindrical bladders, covered with a lid; into theſe is ſecreted a moſt pure and refreſhing water, having the taſte of nectar. There is a kind of cuckow-pint in New France, that if you break a branch of it will afford you a pint of excellent water. How wiſe, how beautiful, is the agreement between the plants of every country, and its inhabitants, and other circumſtances!

2. Plants oftentimes by their very ſtructure contribute remarkably both to their own preſervation and that of others. But the wiſdom of the Creator appears no where more than in the manner of the growth of trees. For as their roots deſcend deeper than thoſe of other plants, proviſion is thereby made, that they ſhall not rob them too much of nouriſhment; and what is ſtill more, a ſtem not above a ſpan in diameter often ſhoots up its branches very high; theſe bear perhaps many thouſand buds, each of which is a plant, with its leaves, flowers, and ſtipulæ. Now if all theſe grew upon the plain, they would take up a thouſand times as much ſpace as the tree does; and in this caſe there would ſcarcely be room in all the earth for ſo many plants as at preſent the trees alone afford. Beſides, plants that ſhoot up in this way are more eaſily preſerved from cattle by a natural defence; and farther, their leaves falling in autumn cover the plants growing about againſt the rigour of the winter; and in the ſummer they afford a pleaſing ſhade, not only to animals, but to plants, againſt the intenſe heat of the ſun. We may add, that trees, like all other vegetables, imbibe the water from the earth; which water does not circulate again to the root, as the ancients imagined, but being diſperſed, like ſmall rain, by the tranſpiration of the leaves, moiſtens the plants that grow around. Again, many trees bear fleſhy fruits of the berry or apple kind, which, being ſecure from the attack of cattle, grow ripe for the uſe of man and other animals, while their ſeeds are diſperſed up and down after digeſtion. Laſtly, the particular ſtructure of trees contributes very much to the propagation of inſects; for theſe chiefly lay their eggs upon the leaves, where they are ſecure from the reach of cattle.

Ever-green trees and ſhrubs in the northern parts are chiefly found in the moſt barren woods, that they may be a ſhelter to animals in the winter. They loſe their leaves only every third year, as their ſeeds are ſufficiently guarded by the moſſes, and do not want any other covering. The palms in the hot countries perpetually keep their leaves, for there the ſeeds ſtand in no need of any ſhelter whatever.

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Many plants and ſhrubs are armed with thorns, *e. g.* the buckthorn, ſloe, carduus, cotton-thiſtle, &c. that they may keep off the animals which otherwiſe would deſtroy their fruit. Theſe at the ſame time cover many other plants, eſpecially of the annual kind, under their branches. Nay, it has frequently been obſerved upon commons where furze grows, that wherever there was a buſh left untouched for years by the commoners, ſome tree has ſprung up, being ſecured by the prickles of that ſhrub from the bite of cattle. So that while the adjacent grounds are robbed of all plants by the voracity of animals, ſome may be preſerved to ripen flowers and fruit, and ſtock the parts about with ſeeds, which otherwiſe would be quite extirpated.

All herbs cover the ground with their leaves, and by their ſhade hinder it from being totally deprived of that moiſture which is neceſſary to their nouriſhment. They are moreover an ornament to the earth, eſpecially as leaves have a more agreeable verdure on the upper than the under ſide.

The moſſes which adorn the moſt barren places, at the ſame time, preſerve the leſſer plants when they begin to ſhoot, from cold and drought; as we find by experience in our gardens, that plants are preſerved in the ſame way. They alſo hinder the fermenting earth from forcing the roots of plants upwards in the ſpring; as we ſee happen annually to trunks of trees, and other things put into the ground. Hence very few moſſes grow in the warmer climates, as not being ſo neceſſary to that end in thoſe places.

The Engliſh ſea mat-weed, or marran, will bear no ſoil but pure ſand, which nature has allotted to it. Sand, the produce of the ſea, is blown by winds oftentimes to very remote parts, and deluges, as it were, woods and fields. But where this graſs grows, it frequently fixes the ſand, gathers it into hillocks, and thrives ſo much, that by means of this alone at laſt an entire hill of ſand is raiſed. Thus the ſand is kept in bounds, other plants are preſerved free from it, the ground is increaſed, and the ſea is repelled by this wonderful diſpoſition of nature. This ſeems to be the ſame plant which is called in Scotland *bent*, and is particularly uſeful for the purpoſe above mentioned, and only grows among ſand along the ſea-coaſt.

How ſolicitous nature is about the preſervation of graſſes is abundantly evident from hence, that the more the leaves of the perennial graſſes are eat, the more they creep by the roots, and ſend forth offsets. For the Author of nature intended that vegetables of this kind, which have very ſlender and erect leaves, ſhould be copious, and very thick ſet, covering the ground like a carpet; and thus afford food ſufficient for ſo vaſt a quantity of grazing animals. But what chiefly increaſes our wonder is, that although the graſſes are the principal food of ſuch animals, yet they are forbid as it were to touch the flower and ſeed-bearing ſtems, that ſo the ſeeds may ripen and be ſown.

The caterpillar or grub of the moth, although it feeds upon graſſes, to the great deſtruction of them

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in meadows, yet it seems to be formed in order to keep a due proportion between these and other plants; for grasses, when left to grow freely, increase to that degree, that they exclude all other plants; which would consequently be extirpated, unless this insect sometimes prepared a place for them. Hence always more species of plants appear in those places where this caterpillar has laid waste the pastures the preceding year than at any other time.

III. Destruction.

Daily experience teaches us, that all plants, as well as all other created things, must submit to death.

They spring up, they grow, they flourish, they ripen their fruit, they wither, and at last, having finished their course, they die, and return to the dust again, from whence they first took their rise. Thus all black mould, which every where covers the earth, for the greatest part is owing to dead vegetables. For all roots descend into the sand by their branches, and after a plant has lost its stem the root remains; but this too rots at last, and changes into mould. By this means this kind of earth is mixed with sand, by the contrivance of nature, nearly in the same way as dung thrown upon fields is wrought into the earth by the industry of the husbandman. The earth thus prepared offers again to plants from its bosom what it has received from them. For when seeds are committed to the earth, they draw to themselves, accommodate to their nature, and turn into plants, the more subtile parts of this mould by the co-operation of the sun, air, and rains; so that the tallest tree is, properly speaking, nothing but mould wonderfully compounded with air and water, and modified by a virtue communicated to a small seed by the Creator. From these plants, when they die, just the same kind of mould is formed as gave birth to them originally; whence fertility remains continually uninterrupted. Whereas the earth could not make good its annual consumption, unless it were constantly recruited by new supplies.

The crustaceous liverworts are the first foundation of vegetation; and therefore are plants of the utmost consequence in the œconomy of nature, though so despised by us. When rocks first emerge out of the sea, they are so polished by the force of the waves, that scarce any herb can find a fixed habitation upon them; as we may observe every where near the sea. But the very minute crustaceous liverworts begin soon to cover these dry rocks, although they have no other nourishment but that small quantity of mould and imperceptible particles which the rain and air bring thither. These liverworts dying at last turn into a very fine earth; on this earth the imbricated liverworts find a bed to strike their roots in. These also die after a time, and turn to mould; and then the various kinds of mosses, *e. g.* the hypna, the brya, polytricha, find a proper place and nourishment. Lastly, these dying in their turn, and rotting, afford such plenty of new-formed mould, that herbs and shrubs easily root and live upon it.

That trees, when they are dry or are cut down, may not remain useless to the world, and lie as it were melancholy spectacles, nature hastens on their destruction in a singular way: first, the liverworts begin to strike root in them; afterwards the moisture is drawn out of them; whence putrefaction follows. Then the mush-room kinds find a fit place for nourishment on them, and corrupt them still more. The beetle called *dermestes* next makes himself a way between the bark and the wood. The musk-beetle, the copper talc-beetle, and the caterpillar or cossus 812 (*S. N.*) bores an infinite number of holes through the trunk. Lastly, the woodpeckers come, and, while they are seeking for insects, wear away the tree already corrupted; till the whole passes into earth. Such industry does nature use to destroy the trunk of a tree! Nay, trees immersed in water would scarcely ever be destroyed, were it not for the worm that eats ships, which performs this work; as the sailor knows by sad experience. Animal Kingdom.

Thistles, as the most useful of plants, are armed and guarded by nature herself. Suppose there were a heap of clay, on which for many years no plant has sprung up; let the seeds of the thistle blow there, and grow, the thistles by their leaves attract the moisture out of the air, send it into the clay by means of their roots, will thrive themselves, and afford a shade. Let now other plants come hither, and they will soon cover the ground.

All succulent plants make ground fine, of a good quality, and in great plenty; as sedum, crassula, aloe, algæ. But dry plants make it more barren, as heath, pines, moss; and therefore nature has placed the succulent plants on rocks and the driest hills.

Sect. IV. *The Animal Kingdom.*

I. Propagation.

1. The generation of animals holds the first place among all things that raise our admiration when we consider the works of the Creator; and chiefly that appointment by which he has regulated the conception of the fœtus, and its exclusion, that it should be adapted to the disposition and way of living of each animal, is most worthy of our attention.

We find no species of animals exempt from the stings of love, which is put into them to the end that the Creator's mandate may be executed, *Increase and multiply:* and that thus the egg, in which is contained the rudiment of the fœtus, may be fecundated; for without fecundation all eggs are unfit to produce an offspring.

Foxes and wolves, struck with these stings, every where howl in the woods; crowds of dogs follow the female; bulls show a terrible countenance, and very different from that of oxen. Stags every year have new horns, which they lose after rutting time. Birds look more beautiful than ordinary, and warble all day long through lasciviousness. Thus small birds labour to outsing one another, and cocks to outcrow. Peacocks spread forth again their gay and glorious trains. Fishes gather together, and exult in the water; and grashoppers chirp, and pipe, as it were, amongst the herbs. The ants gather again into colonies, and repair to their citadels. We pass over many other particulars which this subject affords, to avoid prolixity.

2. The fecundated egg requires a certain and proportionate degree of heat for the expansion of the

stamina

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ſtamina of the embryo. That this may be obtained, nature operates in different manners; and therefore we find in different claſſes of animals a different way of excluding the fœtus.

The females of quadrupeds have an uterus, contrived for eaſy geſtation, temperate and cheriſhing warmth, and proper nouriſhment of the fœtus, as moſt of them live upon the earth, and are there fed.

Birds, in order to get ſubſiſtence, and for other reaſons, are under a neceſſity of ſhifting place; and that not upon their feet, but wings. Geſtation therefore would be burthenſome to them. For this reaſon they lay eggs, covered with a hard ſhell. Theſe they ſit upon by a natural inſtinct, and cheriſh till the young one comes forth.

The oſtrich and caſſowary are almoſt the only birds that do not obſerve this law; theſe commit their eggs to the ſand, where the intenſe heat of the ſun excludes the fœtus.

Fiſhes inhabit cold waters, and moſt of them have cold blood; whence it happens that they have not heat ſufficient to produce the fœtus. The all-wiſe Creator therefore has ordained, that moſt of them ſhould lay their eggs near the ſhore; where, by means of the ſolar rays, the water is warmer, and alſo fitter for that purpoſe; and alſo becauſe water-inſects abound more there, which afford the young fry nouriſhment.

Salmon, when they are about to lay their eggs, are led by inſtinct to go up the ſtream, where the water is freſh and more pure.

The butterfly-fiſh is an exception, for that brings forth its fœtus alive.

The fiſh of the ocean, which cannot reach the ſhores by reaſon of the diſtance, are alſo exempt from this law. The Author of nature has given to this kind eggs that ſwim; ſo that they are hatched amidſt the ſwimming fucus, called *ſargazo* *.

* *Flor. Zeyl.* 389.

The cetaceous fiſh have warm blood; and therefore they bring forth their young alive, and ſuckle them with their teats.

Many amphibious animals bring forth live fœtuſes, as the viper and the toad, &c. But the ſpecies that lay eggs, lay them in places where the heat of the ſun ſupplies the warmth of the parent.

Thus the reſt of the frog kind, and the lizard kind, lay their eggs in warm waters; the common ſnake, in dunghills, and ſuch like warm places; and give them up to nature, as a provident nurſe, to take care of them. The crocodile and ſea-tortoiſes go aſhore to lay their eggs under the ſand, where the heat of the ſun hatches them.

Moſt of the inſect kind neither bear young nor hatch eggs: yet their tribes are the moſt numerous of all living creatures; inſomuch, that if the bulk of their bodies were proportionate to their quantity, they would ſcarce leave room for any other kinds of animals. Let us ſee therefore with what wiſdom the Creator has managed about the propagation of theſe minute creatures. The females by natural inſtinct meet and copulate with the males; and afterwards lay their eggs: but not indiſcriminately in every place. For they all know how to chooſe ſuch places as may ſupply their offspring in its tender age with nouriſhment, and other things neceſſary to ſatisfy their natural wants: for the mother, ſoon after ſhe has laid her eggs, dies; and were ſhe to live, ſhe would not have it in her power to take care of her young.

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Butterflies, moths, ſome beetles, weevils, bugs, cuckow-ſpit inſects, gall-inſects, tree-bugs, &c. lay their eggs on the leaves of plants, and every different tribe chooſes its own ſpecies of plant. Nay, there is ſcarce any plant which does not afford nouriſhment to ſome inſect; and ſtill more, there is ſcarcely any part of a plant which is not preferred by ſome of them. Thus one inſect feeds upon the flower; another upon the trunk; another upon the root; and another upon the leaves. But we cannot help wondering particularly, when we ſee how the leaves of ſome trees and plants, after eggs have been let into them, grow into galls; and form dwellings, as it were, for the young ones. Thus when the gall-inſect has fixed her eggs in the leaves of an oak, the wound of the leaf ſwells, and a knob like an apple ariſes, which includes and nouriſhes the embryo.

When the tree-bug has depoſited its eggs in the boughs of the fir-tree, excreſcences ariſe ſhaped like pearls. When another ſpecies of the tree-bug has depoſited its eggs in the mouſe-ear chickweed or the ſpeedwell, the leaves contract in a wonderful manner into the ſhape of a head. The water-ſpider excludes eggs either on the extremities of the juniper, which from thence forms a lodging, that looks like the arrow-headed graſs; or on the leaves of the poplar, from whence a red globe is produced. The tree-louſe lays its eggs on the leaves of the black poplar, which turn into a kind of inflated bag; and ſo in other inſtances. Nor is it upon plants only that inſects live and lay their eggs. The gnats commit theirs to ſtagnating waters. The water-inſect called *monoculus* often increaſes ſo immenſely on pools, that the red legions of them have the appearance of blood. Others lay their eggs in other places: *e. g.* the beetle, in dunghills; the dermeſtes, in ſkins; the fleſh-fly, in putrified fleſh; the cheeſe-maggot, in the cracks of cheeſe, from whence the caterpillars iſſuing forth, oftentimes conſume the whole cheeſe, and deceive many people, who fancy the worms are produced from the particles of the cheeſe itſelf, by a generation called *equivocat*, which is extremely abſurd. Others exclude their eggs upon certain animals. The mill-beetle lays its eggs between the ſcales of fiſhes; the ſpecies of gad-fly, on the back of cattle; the ſpecies 1025 (*S. N.*) on the back of the rein-deer; the ſpecies 1026, in the noſes of ſheep. The ſpecies 1028 lodges during the winter in the inteſtinal tube, or the throat of horſes, nor can it be driven out till the ſummer comes on. Nay, inſects themſelves are often ſurrounded with the eggs of other inſects, inſomuch that there is ſcarcely an animal to be found which does not afford food for other animals. Almoſt all the eggs of inſects, when laid, are ordained to undergo, by a wonderful law of nature, various metamorphoſes, *e. g.* the egg of the butterfly, being laid in the cabbage, firſt of all becomes a caterpillar, that feeds on the herb, crawls, and has 16 feet. This afterwards changes into a nymph, that has no feet, is ſmooth, and eats nothing; and laſtly, this burſts into a butterfly that flies, has variety of colours, is hairy, and lives upon honey. What can be more worthy of admiration than that one and the ſame animal ſhould appear on the ſtage of life under ſo many characters,

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as if it were three diſtinct animals. Linnæus (*Amæn. Academ.* tom. ii.) in a treatiſe on the wonders relating to inſects, ſays, "As ſurpriſing as theſe transformations may ſeem, yet much the ſame happens when a chicken is hatched; the only difference is, that this chicken breaks all three coats at once, the butterfly one after another."

The laws of generation of worms are ſtill very obſcure; as we find they are ſometimes produced by eggs, ſometimes by offsets, juſt in the ſame manner as happens to trees. It has been obſerved with the greateſt admiration, that the polypus or hydra (*S. N.* 221.) lets down ſhoots and live branches, by which it is multiplied. Nay more, if it be cut into many parts, each ſegment, put into the water, grows into a perfect animal; ſo that the parts which were torn off are reſtored, and form a complete and perfect animal like that from which it was torn.

3. The multiplication of animals is not tied down to the ſame rules in all; for ſome have a remarkable power of propagating, others are confined within narrow limits in this reſpect. Yet in general we find, that nature obſerves this order, that the leaſt animals, and thoſe which are uſeful and ſerve for nouriſhment to the greateſt number of other animals, are endued with a greater power of propagating than others.

Mites, and many other inſects, will multiply to a thouſand within the compaſs of a very few days; while the elephant ſcarcely produces one young in two years.

The hawk-kind generally lay not above two eggs, at moſt four; while the poultry kind produce from 50 to 100.

The diver, or loon, which is eaten by few animals, lays alſo two eggs; but the duck kind, the moor-game, partridges, &c. and ſmall birds, lay a very large number.

If you ſuppoſe two pigeons to hatch nine times a-year, they may produce in four years 14,760 young. They are endued with this remarkable fertility, that they may ſerve for food, not only for man, but for hawks and other birds of prey. Nature has made harmleſs and eſculent animals fruitful. She has forbid the bird kind to fall ſhort of the number of eggs allotted to each ſpecies: and therefore, if the eggs which they intend to ſit upon be taken away a certain number of times, they preſently lay others in their room, as may be ſeen in the ſwallow, duck, and ſmall birds.

II. Preservation.

1. Preſervation follows generation: this appears chiefly in the tender age, while the young are unable to provide for their own ſupport. For then their parents, though otherwiſe ever ſo fierce in their diſpoſition, are affected with a wonderful tenderneſs or ſenſe of love towards their progeny, and ſpare no pains to provide for, guard, and preſerve them; and that not by an imaginary law, but one given by the Lord of nature himſelf.

Quadrupeds give ſuck to their tender young, and ſupport them by a liquor perfectly eaſy of digeſtion, till nature enables them to digeſt what is more ſolid. Nay, their love toward them is ſo great, that they endeavour to repel with the utmoſt force every thing which threatens danger or deſtruction to them. The ewe, which brings forth two lambs at a time, will not admit one to her teats unleſs the other be preſent and ſuck alſo; leſt one ſhould famiſh, while the other grows fat. Animal Kingdom.

Birds build their neſts in the moſt artificial manner, and line them as ſoft as poſſible, for fear the eggs ſhould get any damage. Nor do they build promiſcuouſly in any place, but there only where they may quietly lie concealed and be ſafe from the attacks of their enemies.

The hanging bird makes its neſt of the fibres of withered plants, and the down of the poplar ſeeds, and fixes it upon the bough of ſome tree hanging over the water, that it may be out of reach.

The diver places its ſwimming neſt upon the water itſelf, amongſt the ruſhes. We deſignedly paſs over many inſtances of the like kind.

Again, birds ſit on their eggs with ſo much patience, that many of them chooſe to periſh with hunger, rather than expoſe the eggs to danger by going to ſeek for food.

The male rooks and crows, at the time of incubation, bring food to the females.

Pigeons, ſmall birds, and other birds which pair, ſit by turns; but where polygamy prevails, the males ſcarcely take any care of the young.

Moſt of the duck kind pluck off their feathers in great quantity, and cover their eggs with them, leſt they ſhould be damaged by the cold when they quit their neſts for the ſake of food; and when the young are hatched, who knows not how ſolicitous they are in providing for them till they are able to fly and ſhift for themſelves?

Young pigeons would not be able to make uſe of hard ſeeds for nouriſhment, unleſs the parents were to prepare them in their crops, and thence feed them.

The owl called the *eagle-owl* makes its neſt on the higheſt precipices of mountains, and in the warmeſt ſpot, facing the ſun; that the dead bodies brought there may by the heat melt into a ſoft pulp, and become fit nouriſhment for the young.

As an exception indeed to this foſtering care of animals, may be mentioned the cuckow, which lays its eggs in the neſt of other ſmall birds, generally the wag-tail, yellow hammer, or white-throat, and leaves the incubation or preſervation of the young to them. This cuſtom of the cuckow is ſo extraordinary, and out of the common courſe of nature, that it would not be credible were it not for the teſtimony of the moſt knowing and curious natural-hiſtorians, ſuch as Ray, Willoughby, Geſner, Aldrovandus, Ariſtotle, &c. But this ſeeming want of inſtinct is accounted for from the ſtructure and ſituation of its ſtomach, which diſqualifies it for incubation †; and its inſtinctive care is ſtill conſpicuous in providing a proper, though a foreign, nidus for its eggs

† See the article *Cuculus.*

Amphibious animals, fiſhes, and inſects, which cannot come under the care of their parents, yet owe this to them, that they are put in places where they eaſily find nouriſhment.

2. As ſoon as animals come to maturity, and want no longer the care of their parents, they attend with the utmoſt labour and induſtry, according to the law and œconomy appointed for every ſpecies, to the preſervation

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ſervation of their lives. But that ſo great a number of them, which occur every-where, may be ſupported, and a certain and fixed order may be kept up amongſt them, behold the wonderful diſpoſition of the Creator, in aſſigning to each ſpecies certain kinds of food, and in putting limits to their appetites. So that ſome live on particular ſpecies of plants, which particular regions and ſoils only produce: ſome on particular animalcula; others on carcaſes; and ſome even on mud and dung. For this reaſon, Providence has ordained that ſome ſhould ſwim in certain regions of the watery element; others ſhould fly: ſome ſhould inhabit the torrid, the frigid, or the temperate zones; and others ſhould frequent deſarts, mountains, woods, pools, or meadows, according as the food proper to their nature is found in ſufficient quantity. By this means there is no terreſtrial tract, no ſea, no river, no country, but what contains and nouriſhes various kinds of animals. Hence alſo an animal of one kind cannot rob thoſe of another kind of its aliment; which, if it happened, would endanger their lives or health: and thus the world at all times affords nouriſhment to ſo many and ſo large inhabitants, at the ſame time that nothing which it produces is uſeleſs or ſuperfluous.

It will not be here amiſs to produce ſome inſtances by which it will appear how providentially the Creator has furniſhed every animal with ſuch cloathing as is proper for the country where they live, and alſo how excellently the ſtructure of their bodies is adapted to their particular way of life; ſo that they ſeem to be deſtined ſolely to the places where they are found.

Monkeys, elephants, and rhinoceroſes, feed upon vegetables that grow in hot countries, and therefore therein they have their allotted places. When the ſun darts forth its moſt fervid rays, theſe animals are of ſuch a nature and diſpoſition, that it does them no manner of hurt; nay, with the reſt of the inhabitants of thoſe parts, they go naked; whereas, were they covered with hairy ſkins, they muſt periſh with heat.

On the contrary, the place of rein-deer is fixed in the coldeſt part of Lapland, becauſe their chief food is the liverwort, which grows no-where ſo abundantly as there; and where, as the cold is moſt intenſe, the rein-deer are clothed, like the other northern animals, with ſkins filled with the denſeſt hair, by the help of which they eaſily defy the keenneſs of the winter. In like manner the rough-legged partridge paſſes its life in the very Lapland Alps, feeding upon the ſeeds of the dwarf birch; and, that they may run up and down ſafely amidſt the ſnow, their feet are feathered.

The camel frequents the ſandy and burning deſarts, in order to get the barren camel's-hay. How wiſely has the Creator contrived for him! he is obliged to go through the deſarts, where oftentimes no water is found for many miles about. All other animals would periſh with thirſt in ſuch a journey: but the camel can undergo it without ſuffering; for his belly is full of cells, where he reſerves water for many days. It is reported by travellers, that the Arabians, when in travelling they want water, are forced to kill their camels, and take water out of their bellies that is perfectly good to drink, and not at all corrupted.

The pelican likewiſe lives in deſart and dry places; and is obliged to build her neſt far from the ſea, in order to procure a greater ſhare of heat to her eggs. She is therefore forced to bring water from afar for herſelf and her young; for which reaſon Providence has furniſhed her with an inſtrument moſt adapted to this purpoſe: She has a very large bag under her throat, which ſhe fills with a quantity of water ſufficient for many days; and this ſhe pours into the neſt, to refreſh her young, and teach them to ſwim.

The wild beaſts, lions, and tygers, come to this neſt to quench their thirſt, but do no hurt to the young.

Oxen delight in low grounds, becauſe there the food moſt palatable to them grows.

Sheep prefer naked hills, where they find a particular kind of graſs called the *feſtuca*, which they love above all things.

Goats climb up the precipices of mountains, that they may browſe on the tender ſhrubs; and in order to fit them for it, they have feet made for jumping.

Horſes chiefly reſort to woods, and feed upon leafy plants.

Nay, ſo various is the appetite of animals, that there is ſcarcely any plant which is not choſen by ſome, and left untouched by others. The horſe gives up the water-hemlock to the goat. The cow gives up the long-leaved water-hemlock to the ſheep. The goat gives up the monks-hood to the horſe, &c.; for that which certain animals grow fat upon, others abhor as poiſon. Hence no plant is abſolutely poiſonous, but only reſpectively. Thus the ſpurge, that is noxious to man, is a moſt wholeſome nouriſhment to the caterpillar. That animals may not deſtroy themſelves for want of knowing this law, each of them is guarded by ſuch a delicacy of taſte and ſmell, that they can eaſily diſtinguiſh what is pernicious from what is wholeſome; and when it happens that different animals live upon the ſame plants, ſtill one kind always leaves ſomething for the other, as the mouths of all are not equally adapted to lay hold of the graſs; by which means there is ſufficient food for all. To this may be referred an œconomical experiment well known to the Dutch, that when eight cows have been in a paſture, and can no longer get nouriſhment, two horſes will do very well there for ſome days; and when nothing is left for the horſes, four ſheep will live upon it.

Swine get proviſion by turning up the earth; for there they find the ſucculent roots, which to them are very delicious.

The leaves and fruits of trees are intended as food for ſome animals, as the ſloth, the ſquirrel; and theſe laſt have feet given them fit for climbing.

Beſides myriads of fiſhes, the caſtor, the ſea-calf, and others, inhabit the water, that they may there be fed; and their hinder-feet are fit for ſwimming, and perfectly adapted to their manner of life.

The whole order of the gooſe-kind, as ducks, merganſer, &c. paſs their lives in water, as feeding upon water-inſects, fiſhes, and their eggs. Who does not ſee, that attends ever ſo little, how exactly the wonderful formation of their beaks, their necks, their feet, and their feathers, ſuit their kind of life; which obſer-

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observation ought to be extended to all other birds.

The way of living of the ſea-ſwallow deſerves to be particularly taken notice of; for as he cannot ſo commodiouſly plunge into the water, and catch fiſh, as other aquatic birds, the Creator has appointed the ſea-gull to be his caterer, in the following manner: When this laſt is purſued by the former, he is forced to throw up part of his prey, which the other catches; but in the autumn, when the fiſhes hide themſelves in deep places, the merganſer ſupplies the gull with food, as being able to plunge deeper into the ſea.

The chief granary of ſmall birds is the knot graſs, that bears heavy ſeeds, like thoſe of the black bind-weed. It is a very common plant, not eaſily deſtroyed, either by the road-ſide by trampling upon it, or anywhere elſe; and is extremely plentiful after harveſt in fields, to which it gives a reddiſh hue by its numerous ſeeds. Theſe fall upon the ground, and are gathered all the year round by the ſmall birds. To which we may add, that many ſmall birds feed upon the ſeeds of plantain, particularly linnets. It is generally known that the goldfinch lives upon the ſeed of thiſtles, from which he has its name in Latin and French. Thus bountiful nature feeds the *fowls of the air*.

The Creator has taken no leſs care of ſome amphibious animals, as the ſnake and frog kind; which, as they have neither wings to fly, nor feet to run ſwiftly and commodiouſly, would ſcarcely have any means of taking their prey, were it not that ſome animals run, as it were, of their own accord, into their mouths. When the rattle-ſnake, a native of America, with open jaws fixes his eyes upon a bird, fly, or ſquirrel, ſitting on a tree, they fly down his throat, being rendered ſtupid, and giving themſelves up as deſtitute of all refuge. How dreadful this ſerpent is to other animals will appear by an account we have in a treatiſe entitled, *Radix Senega*. Where the author (*Amæn. Academ.* tom. 2.) ſays, one of theſe terrible ſerpents got clandeſtinely into the houſe of governor Blake at Carolina; where it would have long lain concealed, had it not been that all the domeſtic animals, as dogs, hogs, turkeys, and fowls, admoniſhed the family by their unuſual cries, equally ſhowing their horror and conſternation, their hair, briſtles, and creſts, ſtanding up on end. On the other hand, we cannot but adore the Creator's great goodneſs towards man, when we conſider the rattle which terminates this ſerpent's tail: for by means of that we have an opportunity of guarding againſt this dreadful enemy; the ſound warning us to fly; which if we were not to do, and we ſhould be wounded by him, the whole body would be turned into a putrid corruption in ſix hours, nay ſometimes in half an hour.

The limits of this article will not permit us to produce more examples of this kind. But whoever will be at the pains to take ever ſo ſlight a view of the wonderful works of the Author of nature, will readily ſee how wiſely the plan, order, and fitneſs of things with divine ends, are diſpoſed.

3. We cannot without the utmoſt admiration behold how providentially the Creator has acted as to the preſervation of thoſe animals which, at a certain time of the year, are by the rigour of the ſeaſon excluded from the neceſſaries of life. Thus the bear in the autumn creeps into the moſs which he has gathered, and there lies all winter; ſubſiſting upon no other nouriſhment but his fat, collected during the ſummer in the cellulous membrane, and which without doubt, during his faſt, circulates through his veſſels, and ſupplies the place of food; to which perhaps is added that fat juice which he ſucks out of the bottom of his feet.

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The hedge-hog, badger, and mole, in the ſame manner fill their winter-quarters with vegetables, and ſleep during the froſts. The bat ſeems cold and quite dead all the winter. Moſt of the amphibious animals get into dens, or to the bottom of lakes and pools.

In the autumn, as the cold approaches, and inſects diſappear, ſwallows migrate into other climes in ſearch of food and a temperature of air more friendly to their conſtitution: though the latter hatches, or thoſe young birds which are incapable of diſtant flights, ſeek for an aſylum againſt the violence of the cold in the bottom of lakes amongſt the reeds and ruſhes; from whence, by the wonderful appointment of nature, they come forth again. See the article HIRUNDO. The periſtaltic motion of the bowels ceaſes in all theſe animals while they are obliged to faſt; whence the appetite is diminiſhed, and ſo they ſuffer the leſs from hunger. To this head may be referred the obſervation of the celebrated Liſter concerning thoſe animals, That their blood, when let into a veſſel, does not coagulate, as that of all other animals; and ſo is no leſs fit for circulation than before.

The moor-fowls work themſelves out walks under the very ſnow. They moult in the ſummer; ſo that about the month of Auguſt they cannot fly, and are therefore obliged to run into the woods; but then the moor-berries and bilberries are ripe, from whence they are abundantly ſupplied with food. Whereas the young do not moult the firſt ſummer; and therefore, though they cannot run ſo well, are able to eſcape danger by flight.

The reſt of the birds who feed upon inſects migrate every year to foreign regions, in order to ſeek for food in a milder climate; while all the northern parts, where they live well in the ſummer, are covered with ſnow.

By theſe migrations, birds alſo become uſeful to many different countries, and are diſtributed overalmoſt all the globe. And it muſt excite our admiration that all of them exactly obſerve the times of coming and going, and that they do not miſtake their way.

Inſects in the winter generally lie hid within their caſes, and are nouriſhed by the ſurrounding liquor like the fœtus of other animals; from whence, at the approach of ſpring, they awake, and fly forth, to the aſtoniſhment of every one.

However, all animals which lie hid in winter do not obſerve theſe laws of faſting. Some provide ſtore-houſes in ſummer and autumn, from which they take what is neceſſary; as mice, jays, ſquirrels, bees.

III. DESTRUCTION.

1. WE have obſerved above, that all animals do not live upon vegetables, but that there are ſome which feed

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feed upon certain animalcula. Nay, there are ſome which ſubſiſt only by rapine, and daily deſtroy numbers of the peaceable kind.

Theſe animals are deſtroyed, but in ſuch a manner that the weaker generally are infeſted by the ſtronger in a continued ſeries. Thus the tree-louſe lives upon plants. The fly called *muſca aphidivora* lives upon the tree-louſe; the hornet and waſp-fly, upon the muſca aphidivora; the dragon fly, upon the hornet and waſp-fly; the ſpider, on the dragon-fly; the ſmall birds on the ſpider; and laſtly, the hawk kind on the ſmall birds.

In like manner, the monoculus delights in putrid waters, the gnat eats the monoculus, the frog eats the gnat, the pike eats the frog, the ſea-calf eats the pike.

The bat and goat-ſucker make their excurſions only at night, that they may catch the moths, which at that time fly about in vaſt quantities.

The woodpecker pulls out the inſects which lie hid in the trunks of trees.

The ſwallow purſues thoſe which fly about in the open air.

The mole purſues worms. The large fiſhes devour the ſmall. Nay, we ſcarcely know an animal which has not ſome enemy to contend with.

Amongſt quadrupeds wild beaſts are moſt remarkably pernicious and dangerous to others, as the hawk kind among birds. But that they may not, by too atrocious a butchery, deſtroy a whole ſpecies, even theſe are circumſcribed within certain bounds. Firſt, as to the moſt fierce of all, it deſerves to be noted how few they are in proportion to other animals. Secondly, the number of them is not equal in all countries. Thus France and England breed no wolves, and the northern countries no tigers or lions. Thirdly, theſe fierce animals ſometimes fall upon and deſtroy one another. Thus the wolf devours the fox. The dog infeſts both the wolf and fox; nay, wolves in a body will ſometimes venture to ſurround a bear. The tiger often kills its own male whelps. Dogs are ſometimes ſeized with madneſs, and deſtroy their fellows, or with the mange deſtroy themſelves.

Laſtly, wild beaſts ſeldom arrive at ſo great an age as animals which live on vegetables. For they are ſubject, from their alkaline diet, to various diſeaſes, which bring them ſooner to an end.

But although all animals are infeſted by their peculiar enemies, yet they are often able to elude their violence by ſtratagems and force. Thus the hare often confounds the dog by her windings.

When the bear attacks ſheep and cattle, theſe draw up together for mutual defence. Horſes join heads together, and fight with their heels. Oxen join tails, and fight with their horns.

Swine get together in herds, and boldly oppoſe themſelves to any attack, ſo that they are not eaſily overcome; and it is worth while to obſerve, that all of them place their young, as leſs able to defend themſelves, in the middle, that they may remain ſafe during the battle.

Birds, by their different ways of flying, oftentimes eſcape the hawk. If the pigeon had the ſame way of flying as the hawk, ſhe would hardly ever eſcape his claws.

It deſerves alſo to be remarked, how much ſome animals conſult their ſafety by night. When horſes ſleep in woods, one by turn remains awake, and, as it were, keeps watch. When monkeys in Braſil ſleep upon trees, one of them keeps awake, in order to give the ſign when the tiger creeps towards them; and in caſe the guard ſhould be caught aſleep, the reſt tear him to pieces. Hence rapacious animals are not always ſucceſsful in their hunting, and are often obliged to labour for a whole day to no purpoſe. For this reaſon the Creator has given them ſuch a nature, that they can bear faſting a long time. Thus the lion lurks in his den many days without famiſhing; and the wolf, when he has once well ſatisfied his hunger, can faſt many weeks without any difficulty.

If we conſider the end for which it pleaſed the Supreme Being to conſtitute ſuch an order of nature, that ſome animals ſhould be, as it were, created only to be miſerably butchered by others, it ſeems that his Providence not only aimed at ſuſtaining, but alſo keeping a juſt proportion amongſt all the ſpecies; and ſo prevent any one of them from increaſing too much, to the detriment of men and other animals. For if it be true, as it moſt aſſuredly is, that the ſurface of the earth can ſupport only a certain number of inhabitants, they muſt all periſh if the ſame number were doubled or trebled.

There are ſome viviparous flies which bring forth 2000 young. Theſe in a little time would fill the air, and like clouds intercept the rays of the ſun, unleſs they were devoured by birds, ſpiders, and many other animals.

Storks and cranes free Egypt from frogs, which, after the inundation of the Nile, cover the whole country. Falcons clear Paleſtine of mice. Bellonius on this ſubject ſays as follows: "The ſtorks come to Egypt in ſuch abundance, that the fields and meadows are white with them. Yet the Egyptians are not diſpleaſed with this ſight; as frogs are generated in ſuch numbers there, that did not the ſtorks devour them, they would over-run every thing. Beſides, they alſo catch and eat ſerpents. Between Belba and Gaza, the fields of Paleſtine are often deſart on account of the abundance of mice and rats; and were they not deſtroyed by the falcons that come here by inſtinct, the inhabitants could have no harveſt"

The white fox is of equal advantage in the Lapland Alps; as he deſtroys the Norway rats, which are generated there in great abundance, and thus hinders them from increaſing too much in proportion, which would be the deſtruction of vegetables.

It is ſufficient for us, that nothing is made by Providence in vain; and that whatever is made, is made with ſupreme wiſdom. For it does not become us to pry too boldly into all the deſigns of God. Let us not imagine, when theſe rapacious animals ſometimes do us miſchief, that the Creator planned the order of nature according to our private principles of œconomy: for the Laplanders have one way of living; the European huſbandman another; the Hottentots and ſavages a third; whereas the ſtupendous œconomy of the Deity is one throughout the globe; and if Providence does not always calculate exactly according to our way of reckoning, we ought to conſider this affair in the ſame light, as when different ſea-

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men wait for a fair wind, every one with reſpect to the part he is bound to, who we plainly ſee cannot all be ſatisfied.

2. The whole earth would be overwhelmed with carcaſes and ſtinking bodies, if ſome animals did not delight to feed upon them Therefore, when an animal dies, bears, wolves, foxes, ravens, &c. do not loſe a moment till they have taken all away. But if a horſe *e. g.* dies near the public road, you will find him, after a few days, ſwoln, burſt, and at laſt filled with innumerable grubs of carniverous flies, by which he is entirely conſumed, and removed out of the way, that he may not become a nuiſance to paſſengers by his poiſonous ſtench.

When the carcaſes of fiſhes are driven upon the ſhore, the voracious kinds, ſuch as the thornback, the hound-fiſh, the conger-eel, &c. gather about and eat them. But becauſe the flux and reflux ſoon change the ſtate of the ſea, they themſelves are often detained in pits, and become a prey to the wild beaſts that frequent the ſhores. Thus the earth is not only kept clean from the putrefaction of carcaſes, but at the ſame time, by the œconomy of nature, the neceſſaries of life are provided for many animals. In the like manner many inſects at once promote their own good, and that of other animals. Thus gnats lay their eggs in ſtagnant, putrid, and ſtinking waters, and the grubs that ariſe from theſe eggs clear away all the putrefaction: and this will eaſily appear, if any one will make the experiment by filling two veſſels with putrid water, leaving the grubs in one, and taking them all out of the other; for then he will ſoon find the water that is full of grubs pure and without any ſtench, while the water that has no grubs will continue ſtinking.

Lice increaſe in a wonderful manner in the heads of children that are ſcabby; nor are they without their uſe, for they conſume the redundant humours.

The beetle kind in ſummer extract all moiſt and glutinous matter out of the dung of cattle, ſo that it becomes like duſt, and is ſpread by the wind over the ground. Were it not for this, the vegetables that lie under the dung would be ſo far from thriving, that all that ſpot would be rendered barren.

As the excrements of dogs is of ſo filthy and ſeptic a nature that no inſect will touch them, and therefore they cannot be diſperſed by that means, care is taken that theſe animals ſhould exonerate upon ſtones, trunks of trees, or ſome high place, that vegetables may not be hurt by them.

Cats bury their dung. Nothing is ſo mean, nothing ſo little, in which the wonderful order and wiſe diſpoſition of nature do not ſhine forth.

Laſtly, all theſe treaſures of nature, ſo artfully contrived, ſo wonderfully propagated, ſo providentially ſupported throughout her three kingdoms, ſeem intended by the Creator for the ſake of man. Every thing may be made ſubſervient to his uſe, if not immediately, yet mediately; not ſo to that of other animals. By the help of reaſon man tames the fierceſt animals; purſues and catches the ſwifteſt; nay, he is able to reach even thoſe which lie hid in the bottom of the ſea.

By the help of reaſon, he increaſes the number of vegetables immenſely; and does that by art, which nature, left to herſelf, could ſcarcely effect. By ingenuity he obtains from vegetables whatever is convenient or neceſſary for food, drink, cloathing, medicine, navigation, and a thouſand other purpoſes.

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He has found the means of going down into the abyſs of the earth, and almoſt ſearching its very bowels. With what artifice has he learned to get fragments from the moſt rocky mountains, to make the hardeſt ſtones fluid like water, to ſeparate the uſeful metal from the uſeleſs droſs, and to turn the fineſt ſand to ſome uſe! In ſhort, when we follow the ſeries of created things, and conſider how providentially one is made for the ſake of another, the matter comes to this, that all things are made for the ſake of man; and for this end more eſpecially, that he, by admiring the works of the Creator, ſhould extol his glory, and at once enjoy all thoſe things of which he ſtands in need, in order to paſs his life conveniently and pleaſantly.

Beſides general natural hiſtories, which we have here given a ſpecimen of, as thoſe of Pliny, &c. there are likewiſe particular ones; and thoſe of two kinds. The firſt, thoſe which only conſider one kind of things; ſuch as the Hiſtory of Shells, by Dr Liſter; of Fiſhes, by Willughby; that of Birds, by the ſame; that of Plants, by Ray; thoſe of Inſects, by Swammerdam and Mouffet; that of Animals, by Geſner; that of Foſſils, by Agricola, Mercatus, &c.

The ſecond, thoſe which conſider the ſeveral kinds of natural things found in particular countries or provinces: as, the Natural Hiſtory of Dauphiné, by Chorier; the Natural Hiſtory of the Antilles, by F. Du Tertre, and M. Lonvillers De Poincy; that of Oxfordſhire and Staffordſhire, by Dr Plott; that of Lancaſhire, by Leigh; of Northamptonſhire, by Morton; that of the Weſtern Iſlands, by Martin, &c.

The natural hiſtory only of one particular place, is a ſubject very extenſive in its materials, and not to be ſet about without great care and circumſpection. Mr Boyle has favoured the world with a liſt of the heads under which to arrange things, and what to enquire after on ſuch an occaſion.

The general heads under which he comprehends the articles of this hiſtory are four; the things which regard the heavens, the air, the waters, and the earth.

To theſe general heads Mr Boyle imagines ſhould be added, inquiries into traditions in the country, of any thing relating to it, whether peculiar to it, or only more common there than elſewhere; and where theſe require learning or ſkill in the anſwerer, the utmoſt care is to be taken to put the people in a way to give their accounts in a ſatisfactory manner; for a falſe or bad account of any thing is always much worſe than no account at all.

This ſubject concerning the works of nature, a very ſmall part of which we have been able to touch upon, is of ſuch importance and dignity, that if it were to be properly treated in all its parts, men would find wherewithal to employ almoſt all the powers of the mind: nay, time itſelf would fail before, with the moſt acute human ſagacity, we ſhould be able to diſcover the amazing œconomy, laws, and exquiſite ſtructure, even of the leaſt inſect; ſince, as Pliny obſerves, nature nowhere appears more herſelf than in her moſt minute works.

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Summary as it is, however, the preceding view, as it were in a map, of the ſeveral parts of nature, their connections and dependencies, may at leaſt, perhaps, convey an uſeful leſſon, and ſuch an one as the beſt of us often need to have inculcated.

From a partial conſideration of things, we are very apt to criticiſe what we ought to admire; to look upon as uſeleſs what perhaps we ſhould own to be of infinite advantage to us, did we ſee a little farther; to be peeviſh where we ought to give thanks; and at the ſame time to ridicule thoſe who employ their time and thoughts in examining what we were (*i. e.* ſome of us moſt aſſuredly were) created and appointed to ſtudy. In ſhort, we are too apt to treat the Almighty worſe than a rational man would treat a good mechanic, whoſe works he would either thoroughly examine or be aſhamed to find any fault with. This is the effect of a partial conſideration of nature; but he who has the candour of mind and leiſure to look farther, will be inclined to wonder and adore, and even to cry out with the poet,

How wond'rous is this ſcene! where all is form'd
With number, weight, and meaſure! all deſign'd
For ſome great end! where not alone the plant
Of ſtately growth; the herb of glorious hue,
Or food-full ſubſtance; not the labouring ſteed;
The herd, and flock, that feed us; not the mine
That yields us ſtores for elegance and uſe;
The ſea that loads our table, and conveys
The wanderer man from clime to clime; with all
Thoſe rolling ſpheres, that from on high ſhed down
Their kindly influence: not theſe alone,
Which ſtrike ev'n eyes incurious; but each moſs,
Each ſhell, each crawling inſect, holds a rank
Important in the plan of Him who fram'd
This ſcale of beings; holds a rank, which loſt
Would break the chain, and leave behind a gap
Which nature's ſelf would rue. Almighty Being,
Cauſe and ſupport of all things, can I view
Theſe objects of my wonder, can I feel
Theſe fine ſenſations, and not think of thee?
Thou who doſt thro' th' eternal round of time,
Doſt thro' th' immenſity of ſpace exiſt
Alone, ſhalt thou alone excluded be
From this thy univerſe? Shall feeble man
Think it beneath his proud philoſophy
To call for thy aſſiſtance, and pretend
To frame a world, who cannot frame a clod?—
Not to know thee, is not to know ourſelves ——
Is to know nothing—nothing worth the care
Of man's exalted ſpirit—All becomes,
Without thy ray divine, one dreary gloom,
Where lurk the monſters of fantaſtic brains,
Order bereft of thought, uncaus'd effects,
Fate freely acting, and unerring Chance.
Where meanleſs matter to a chaos ſinks,
Or ſomething lower ſtill: for without thee
It crumbles into atoms void of force,
Void of reſiſtance—it eludes our thought.
Where laws eternal to the varying code
Of ſelf-love dwindle. Intereſt, paſſion, whim,
Take place of right and wrong: the golden chain
Of being melts away, and the mind's eye
Sees nothing but the preſent. All beyond
Is viſionary gueſs—is dream—is death.

Vol. XII. Part. II. Thomson.

Animal Kingdom.

We ſhall add to this article the following deſcription of a muſeum: The windows ought to be in the two longeſt ſides of the building, that it may be equally lighted during the whole day.

On one wing of the muſeum muſt be placed eleven preſſes, with ſhelves ſupported on wooden brackets. Theſe preſſes are intended for containing the eleven following claſſes of the *mineral kingdom* (a kingdom which forms the original baſis of every thing pertaining to this globe: minerals have neither organization nor life), *viz.*

1. Waters.
2. Earths.
3. Sands.
4. Stones.
5. Salts.
6. Pyrites.
7. Semimetals.
8. Metals.
9. Bitumens and ſulphurs.
10. Volcanic productions.
11. Petrifactions, foſſils, and *luſus naturæ*.

We at once perceive the advantage of ſuch an arrangement, where every thing is diſtinct and diſtributed in the manner moſt advantageous for the inſpection of the ſtudent. The preſſes muſt be provided with a wire grate, or covered with glaſs; and each of them muſt have a title on the cornice, indicating the claſs which it contains. Beſides this, each ſhelf in the preſs ought to have a ſmall title on the edge, ſpecifying the kind of ſubſtances which are placed on it; and theſe ſhould be kept in clear glaſs-bottles, well ſealed and furniſhed with proper titles alſo. In them are to be ſeen earths, clays, turfs, ochres, chalks, marls, lapis ollaris, and micaceous ſtones, calcareous or limeſtones, ſpars, congelations, ſtony reſidua, ſtalactites, alabaſter, gypſum or plaſter-ſtone, flints, rock-ſtones, rock and mineral cryſtals, ſalts, and pyrites ſubject to efflorescence, coals and other bituminous bodies, lava, and the droſs of volcanoes. In the bottom of each preſs two ſpaces may be reſerved and furniſhed with a conſiderable number of ſmall ſemicircular ſhelves, where pieces much eſteemed, and in complete preſervation, may be placed by themſelves or on very ſmall pedeſtals; ſuch as tranſparent mineral ſalt, collections of coloured pyrites, the ſtone called the *Inca's*-ſtone, beautiful ſpecimens of cobalt, biſmuth, zinc, antimony, ore of fluid, quickſilver, and cinnabar in cryſtals: the whole properly titled and arranged according to their claſſes.

The preſs for *metals* ought to preſent us in the ſame order with ſelect and rare ſpecimens of the ores of white, green, &c lead, the ore of nickel, collections of cryſtalliſed tin, the *flos-ferri*, beautiful needles of hematite, a powerful rough loadſtone, with ſome platina, the ſilky copper of China, and a collection of malachite; likewiſe virgin ſilver in vegetation and red ſilver, together with a collection of golden ore. Theſe ſubſtances form a ſpectacle equally varied and inſtructive: in this department of her works nature is as rich and brilliant as in the various kinds of ſtones.

The preſs for *bitumens* may in like manner contain ſpecimens of jet poliſhed on one ſide; amber of different colours (which when it is tranſparent, and contains inſects, ought to be poliſhed on the two oppoſite ſurfaces); a beautiful ſpecimen of ambergris, together with pieces of tranſparent red and yellow ſulphur.

In the preſs for *petrifactions* or for *foſſils*, we muſt likewiſe place, on ſemicircular ſhelves, the rareſt and

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the beſt preſerved pieces; ſuch as lilium lapideum, madrepores, tranſparent belemnites, foſſil urchins, the articulated nautilus, cornua ammonis ſawed and poliſhed, hyſterolite, lapis lenticularis, gryphites calculi or bezoars, turquoiſes, loadſtones, gloſſopetræ; in ſhort, all kinds of figured ſtones, and alſo petrified wood.

In the preſs for *ſtones*, which has a ſimilar apparatus of ſhelves, we ſee different kinds of cryſtals, and all the precious ſtones in their matrix. Thoſe which are detached and uncut are placed in caſes or watch-glaſſes; but thoſe which have been cut and ſet are to be put in a jewel-box or open caſe for rings. The ſame is to be obſerved with regard to pieces, cups, ciſterns, or poliſhed plates of agate, cornelian, jade, ſardonyx, onyx, chalcedony, jaſper, porphyry, granite, lapis lazuli, marble, alabaſter, and Iceland cryſtal. Here likewiſe are to be placed the Bologna ſtone, the Labrador ſtone, the ſerpentine ſtone, talc, amianthus, zeolite, baſaltes, touch-ſtone, together with Egyptian and Engliſh flints. With regard to impreſſed petrifactions, large arborizations, and Florence ſtones, if they are in good preſervation: they ſhould be framed and ſuſpended by hooks on the pilaſters which connect the preſſes of the mineral kingdom. Theſe preſſes are of an uniform height; but their breadth is proportioned to the ſize or number of the materials compoſing the claſs which it contains, and they are ſupported, as well as thoſe which are placed all around, on a cheſt of drawers breaſt high. Theſe drawers muſt correſpond to the preſſes above them, and contain ſubſtances of the ſame claſs. This methodical arrangement is a great help to the memory; becauſe it occaſionally ſupplies the place of a numbered catalogue, and becauſe in a great multitude of objects it is the only means of finding at once what we want.

In the mineral kingdom, theſe drawers are very uſeful for containing earths, belemnites, entroches, aſtroites, and other polymorphous foſſils, univalve, bivalve, and multivalve ſhells, poliſhed petrifactions of bones and pieces of wood, collections of marbles and poliſhed flints, collections of ſilex, ſands, and amber, together with pieces procured from the melting of ores, ſuch as regulus, droſs, &c. Some parts of the mineral kingdom, ſuch as the earths and certain ſtones, make not a brilliant figure in a muſeum; they are notwithſtanding the moſt ſcientific parts of it, and the moſt intereſting to thoſe who prefer the ſolid ſatisfaction of tracing nature in her moſt important productions, and her fundamental operations, to the empty ſpectacle of gaudy colours and agreeable figures.

Minerals in general require to be kept with great care, and ſo as not to be intermixed. Some of them, ſuch as the ſalts, eaſily diſſolve; and others, as the pyrites, are ſubject to efflorescence. Vegetables and animals are likewiſe more or leſs liable to corruption; and to prevent this inconvenience, great pains muſt be taken in preſerving certain pieces which are ſubject to ſpeedy decay.

On the *ſecond* wing of the cabinet are to be placed ten preſſes, diſtributed like thoſe of the mineral kingdom, and intended for containing the ten following diviſions of the *vegetable kingdom*. Vegetables are organiſed bodies, but they poſſeſs not, like animals, ſpontaneous motion or feeling.

1. Roots.
2. Barks.
3. Woods and ſtalks.
4. Leaves.
5. Flowers.
6. Fruits and ſeeds.
7. Paraſite plants, alſo agarics and muſhrooms.
8. The juices of vegetables; ſuch as balſams and ſolid reſins, reſinous gums, and gums properly ſo called.
9. Extracted juices, ſugars, and dregs.
10. Marine plants, and plants growing on the ſhores of the ſea.

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In this kingdom, the ſame order of preſſes, the ſame ſymmetry and arrangement, are to be obſerved as in the mineral kingdom. The ſemicircular ſhelves in the bottom of the preſſes are here very uſeful for containing in ſmall ſquare phials China varniſh, eſſential oils, and other peculiar aromatics, whether of Arabia or India; together with the roots of cumbou, mandragora, certain fruits, either monſtrous or natural, which grow in the Eaſt Indies, and which the natives ripen in large bottles with narrow necks, preſerved in ſpirits, ſuch as the caſhew-nut, &c. Here likewiſe are placed a number of fruits, remarkable for their rarity or great ſize; as cocoa nuts, gourds, the fruit of the baſtard locuſt-tree, the fruit of the ſand-box-tree, banana figs, pine-apples, coloquintida apple, dogſbane, vegetable tumors or wens, and a branch of *bois de dentelle*, in which the three parts of the bark, eſpecially the *liber*, are diſtinctly ſeparated.

As the number of vegetables greatly exceeds that of minerals, we ſeldom put any thing in bottles but the dried parts of exotic plants, which are uſed either in medicine or in the arts, and thoſe likewiſe which we cultivate merely from curioſity. With regard to indigenous plants, an *herbal* is formed of land and ſea plants, paſted or laid between leaves of paper collected into the ſhape of a book, and arranged according to the ſyſtem of the beſt botaniſts. To make this herbal as convenient as poſſible, it is proper to put the dried plants between two folds of dry paper, and, arranging them according to their families, genera, and ſpecies, to pile them one above another, either openly on the ſhelves or in large band-boxes On the back of the band-boxes muſt be a title indicating the family, at the extremity another with the name of the genus, and on each leaf the name of the ſpecies which it contains: the paper muſt be looſe, that they may be changed at pleaſure. The drawers are uſeful partly for holding different kinds of woods with the bark, cut in ſuch a manner as that the grain and contexture of it may eaſily be diſtinguiſhed, and for containing a collection of the woods of both Indies in ſmall poliſhed pieces with proper titles. One part of the drawers has ſeveral diviſions within for the purpoſe of holding ſeeds; and a ſmall title is inſcribed on each of theſe diviſions.

Sea-weeds, and ſmall marine plants of an elegant ſhape, which from their colour and variety form agreeable pictures, may be framed and ſuſpended by hooks to the pilaſters of the preſſes. In the animal kingdom, particularly inſects, it is well known, are attended with irreparable devaſtations. Butterflies,

ſtill

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ſtill more than the moſt beautiful birds, are not only ſubject to deſtruction in this way, but are alſo expoſed to great danger from the rays of the ſun, either direct or reflected, which alter their colour, make them loſe all their ſplendor, and, in ſome ſpecies, render it impoſſible to diſtinguiſh them. In general, we cannot prevent the deſtruction of vegetables and animals, but by drying them as much as poſſible, or by putting them in prepared liquors, which muſt not be allowed to evaporate. But dried animals and vegetables require ſtill greater care: a great multitude of inſects which are bred in the month of April feed upon them, and deſtroy them internally before they are perceived: they ought to be carefully watched during the continuance of this plague, which is about five months. In like manner, the moiſture of winter and the heat of ſummer make it neceſſary that the preſſes of muſæums ſhould be kept carefully ſhut, except perhaps thoſe which front to the north. Beſides, the vapour of ſulphur in combuſtion will kill theſe deſtructive inſects either before or after they become perfect ones: the fumigations muſt be carefully performed during dry weather, and in a box made on purpoſe, into which only the ſpecimens attacked are introduced.

On the third wing of the cabinet are placed preſſes for containing the ten following diviſions of the *animal kingdom* (a kingdom which derived the ſubſtance neceſſary to its exiſtence either mediately or immediately from the vegetable kingdom.——Animals poſſeſs feeling and ſpontaneous motion.)

1. Lithophytes.
2. Zoophytes.
3. Teſtaceous animals.
4. Cruſtaceous animals.
5. Inſects.
6. Fiſhes.
7. Amphibious animals, reptiles, and oviparous quadrupeds.
8. Birds, with their neſts and eggs.
9. Viviparous quadrupeds.
10. Man.

In theſe preſſes the ſame external decoration and diſtribution may be obſerved as in the preceding ones.

The preſs for the *lithophytes* muſt be arranged in ſuch a manner as to preſent at one view the hiſtory of lithophytes, mandreporæ, and coral either rough or ſtript of its covering; the whole placed on ſmall wooden pedeſtals, blackened or gilded. Corallines, as well as fuci, may be paſted on a bit of paper, and put into a frame: ſuch pictures, when ſuſpended by hooks to the outſide of the pilaſters, always attract the attention of the ſpectators. If we have a conſiderable collection of them, it will be neceſſary to make a kind of herbal of them.

The preſs for *zoophytes* contains ſponges, the marine jet d'eau, the penna marina, holothuriæ, and all thoſe ſubſtances which are called *animal plants*, molluſcæ, worms, &c. Theſe productions muſt be preſerved in rectified ſpirit of wine, which will be ſufficiently weakened by the water contained in them. Upon the ſides are ſea-ſtars, both prickly and ſmooth, with ſeveral rays, a Meduſa's head, &c.

The *teſtaceous* animals are preſerved in bottles among ſpirits. On the ſemicircular ſhelves at the bottom of the preſs are placed large ſhells, and ſmall ones with their marine covering.

The preſs for *cruſtaceous* animals conſiſts almoſt entirely of ſemicircular ſhelves; and contains crabs, crayfiſh, &c. Small lobſters, ſquillæ, and all ſmall cruſtaceous animals, excepting the hermit crab, are put in frames.

Two kinds of inſects are found in the preſs deſtined for them. The firſt kind, after being dried, are put in ſmall wooden frames, which are varniſhed and glazed on two ſides, that we may have it in our power to examine the inſect on both ſides: of this kind are flies, mantes, beetles, butterflies with their nymphæ or chryſalides, &c. (Theſe animals form the moſt brilliant part of the cabinet, while the preſs for birds is the moſt ſtriking; but great pains muſt be uſed in their preſervation.) Other inſects, ſuch as graſhoppers, ſcolopendræ, ſcorpions, ſalamanders, ſpiders, tarantulas, caterpillars, and eſpecially all ſoft inſects, muſt be preſerved in ſpirits, and placed on ſemicircular ſhelves at the bottom of the preſs. Here alſo are depoſited honey-combs, waſps neſts, and branches furniſhed with the neſts of thoſe inſects which produce the gum-lac.

In the preſs for *fiſhes* are to be ſeen bottles containing foreign fiſhes, which are always ſent home in ſpirits. The ſoft fiſhes of our own country are preſerved in the ſame manner. The ſkin of large fiſhes, whether found in ſalt or freſh water, is taken off and paſted on a bit of paper: the two parts are ſometimes ſewed together, and the colours are renewed by means of varniſh. The flying fiſh muſt be ſuſpended about the top of the preſs; and armed fiſhes, with oſtracia, on the ſhelves below.

The preſs for *amphibious* animals contains, in bottles full of ſpirit of wine diluted with alum water, ſerpents, vipers, adders, frogs, toads, lizards, ſmall land or water turtles, and a ſmall tortoiſe with its ſhell. The lower ſhelves are furniſhed with a ſmall rattle-ſnake, a cameleon, a crocodile, a beaver, a ſea-lion, a ſea-calf, &c.

The preſs for *birds* is filled with animals of that claſs, both foreign and natives, ſtuffed and provided with glaſs eyes. The ſkin covered with the feathers may be preſerved perfect and dry by being fitted to a mould of tree-moſs, or filled with cotton, and ſprinkled on the inſide with pepper, camphire, and corroſive ſublimate, to defend it from the attack of moths, grubs, wood-lice, and dermeſtes. The ſpring and autumn are the beſt ſeaſons for this operation; the moulting-time is very improper, becauſe it is unfavourable to the beautiful colour and the preſervation of the feathers, which moreover are then full of blood. The birds, when thus prepared, and when the brain has been taken out, are then placed on their ſupports.—Some females may be placed in their neſts in the attitude of incubation; thoſe which are accuſtomed to perch may be placed on artificial trees; a wooden ſupporter, covered with moſs, turf, or artificial reeds, may be given to thoſe which live among ſuch plants.—Swimming birds are placed on the lowermoſt ſhelves, which muſt be covered with pieces of mirrors or ſilver gauze, in imitation of water. We muſt be careful to give each animal the moſt pictureſque attitude; to preſerve the proportions, together with the natural poſition of the legs, wings, head, body, and feathers; to obſerve an equilibrium in thoſe which are at reſt, and to avoid it in thoſe which have a fighting attitude.—We muſt characterize the animal, repreſent his genius,

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dispositions, graces, boldness, or timidity. In short, we must endeavour to express that beautiful *tout ensemble* which gives the appearance of life and motion to the whole. The deception ought to be such, that those who examine the particulars of the collection may apply to each what was said on another occasion—*Nature is dead, but Art is alive.* These observations on birds are equally applicable to the other animals; but all of them must be arranged in a methodical order, which possesses the advantage necessary in such collections of uniting pleasure with instruction.

The lower shelves contain the eggs and nests of birds; and a collection of feathers is made in a book in the same manner as an *herbal.*

The press for *quadrupeds* contains, preserved in bottles, small animals, such as mice, rats, the opossum, &c. Other animals are stuffed, such as the cat, the squirrel, the hedge-hog, the porcupine, the armadillo, the Guinea pig, the wolf, the fox, the roe-buck, the hare, the dog, &c.

The press containing the *history of man* consists of a complete myology, of a head separately injected, of a brain and the organs of generation in both sexes, of a neurology, an osteology, embryos of all different ages, with their after-births, monstrous fœtuses, and an Egygtian mummy. Here likewise are put beautiful anatomical pieces in wax or wood, and stony concretions extracted from the human body.

The preservation of subjects in bottles with spirit of wine does not always succeed, because they spoil as the spirit of wine evaporates, unless particular care be taken to examine the vessels wherein they are contained; which requires time and pains, and is attended with expence. Mr Lewis Nicola, in the Philadelphia Transactions for the year 1771, recommends, after using the different methods pointed out by M. Reaumur, of putting subjects intended for preservation in bottles filled with spirit of wine, to wipe well the neck of the bottle, and put a layer of putty, two lines thick, over the piece of skin or bladder which covers it. The bottle is then reversed in a wooden cup, which they fill with melted tallow, or with a mixture of tallow and wax, to prevent the spirit of wine from evaporating.

The drawers under the presses of the *animal kingdom* contain small detached parts of animals, such as teeth, small horns, jaw-bones, claws, beaks, nails, vertebræ, hairs, scales, balls of hair, and a collection of bones remarkable for blows, fractures, deformities, and diseases.

To decorate a cabinet to the greatest advantage, and to make one complete whole, the walls must be furnished throughout their whole extent. For this purpose the tops of the presses are commonly ornamented with shells of a very great size, foreign wasps-hives, the horn of a rhinoceros, an elephant's trunk, the horn of an unicorn, urns and busts of alabaster, jasper, marble, porphyry, or serpentine stone. Here likewise are placed figures of antique bronze, large lithophytes, animals made of shells, bouquets made of the wings of Scarabæub gourds cut into two, painted, and made into bowls, plates, vases, and as they are used by savages; little trunks of bark, books made of the leaves of the palm-tree, globes, spheres, &c. The multiplicity and singularity of the objects never fail to arrest the attention of the spectator.

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The circumference of the cabinet being furnished in the manner we have described, the floor may likewise be paved with different kinds of common stones which are susceptible of a polish.

The cieling, which must be very white, is divided into three spaces, furnished with hooks and brass wires. Here may be distributed in order different vegetable and animal productions, which are of too great a size to be contained in the presses; such as,

1. The sugar-cane, a branch of the palm-tree, together with that called the *Chinese fan*, large cocoas, both simple and with a double lobe, the leaf of the banana-tree, Indian and European sticks, remarkable for the knots, tubercles, and spiral wreaths, which cover their whole length, a bamboo root divided longitudinally into two parts, and the different species of reed-canes.

2. The skins of large animals; also stuffed animals, such as lizzards, whether a crocodile or caiman and scaly lizard, a shark, a sword-fish, a sea-calf, a sea-tortoise, large and long serpents, the horns of deer, wild goats, roe-bucks, and rein-deer.

3. The third space is filled with Indian rackets, hammocks, dresses, and tufts of feathers; with calumets or pipes; with quivers, bows, and arrows; with head-pieces, caps with feathers, aprons, necklaces, Chinese necessaries, fans made of the leaves of the palm tree, a gargoulette of Indostan, a Polish whip, Indian canoes, Chinese musical instruments, lances, weapons, Indian furniture and utensils; and in short, various curiosities from nations ancient and modern, if they can be found; various furniture and utensils of different nations, ancient and modern.

As the great extent of a fine collection requires that there be no empty space, stands may be placed in different parts of the room, especially at the corners, for supporting large vertebræ, the head of a sea-cow, very large madrepores, or considerable collections either of rock chrystal or of minerals.

In the middle of the room is placed a receptacle for shells, which is a large table or bureau with raised edges. The surface of this table is divided into 27 separate cases, of different sizes, and proportioned to the 27 families of marine shells to be deposited in them. These divisions are made with wood or pasteboard painted blue, and are sometimes in the form of shelves; the bottom is covered with blue cotton or green sattin, or, what is still simpler, with white linen, sufficiently rough to keep the shells in their place. In some cabinets, these shelves are covered with mirrors on all their different surfaces, which shows the objects double, and gives us an opportunity of viewing them on the two opposite sides. In other cabinets, the cases for each family are distributed into a number of smaller divisions, for containing the several species separate from each other. The sea-shells, contained in the receptacle for shells, are all cleaned, and present, in the variety of their figure and colours, together with their inequality, an agreeable and enchanting picture, so much the more charming that it unites a methodical distribution to a symmetrical order. The upper part of this table is shut by a net-

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work of braſs wire covered with ſerge, or, what is ſtill better, by a glaſs frame, to defend the ſhells from duſt. We muſt not omit to mention, that in the middle of the table there is a long elevated ſquare box, containing land and river ſhells. From the middle of each compartment, or at each family of ſhells, ariſes a ſmall pyramidal wooden pillar, on the top of which is an horizontal piece of paſteboard, or ſort of ſign, denoting the kind of ſhells belonging to that diviſion. Each family is diſtinguiſhed from the adjoining one by thoſe kind of ornaments of ſilk called *caterpillars*. By means of the different tints, we perceive the limits and extent of each family in the ſame manner as the colours in a geographical map enable us to diſtinguiſh the ſeveral provinces of the ſame empire. An exhibition of this kind was to be ſeen from 1768 to 1774, in a muſeum belonging to the prince of Condé at Chantilly.

Under the table for ſhells, on the ſide of the windows, is a glazed cage, large enough to contain the ſkeletons of an animal belonging to each claſs, to wit, a fiſh, an amphibious animal, a reptile, a lizard, a bird, and a quadruped. When to theſe we can add, for the ſake of the comparative oſteology, the ſkeletons of the intermediate individuals of theſe animals, together with thoſe which make the neareſt approaches to man, ſuch as the *monkey* and the *bear*, we greatly increaſe both the pleaſure and inſtruction. Below this table are likewiſe placed the beſt books connected with the different branches of natural hiſtory, eſpecially ſuch as have illuminated plates. The difficulty of acquiring the moſt valuable objects, and of preventing their deſtruction when once acquired, obliges us to have recourſe to figures, in order to preſerve a repreſentation of them. This is an infallible method of communicating, not only to our cotemporaries, but alſo to poſterity, the diſcoveries of the age in which the work was compoſed. Here alſo may be depoſited the *herbal* and the collection of *feathers*, arranged in the form of books.

The ſpace above the door is furniſhed with a large frame, filled with the ſkins of rare fiſhes, which are dried, varniſhed, and paſted on paper.

The piers of the windows are furniſhed with one or two preſſes, which are provided with ſhelves, and contain different kinds of inſtruments employed in phyſics, ſuch as an air-pump, a burning mirror, a perſpective glaſs, a magnifier, a microſcope, a teleſcope, magnets both natural and artificial, &c.

On the ſemicircular ſhelves below are placed ſtones formerly uſed by ſavages for hatchets. Some curious pieces of lacker work, Indian pagodas, trinkets belonging to the ſavages of the north and to the Chineſe, which are made of ivory or yellow amber, or of coral mounted with gold, ſilver, porcelain-clay, *kriacks* of Siam, and Turkiſh *cangiars*, which are a kind of poniards, Indian curioſities of ſilver, and the galians which the Turks and Perſians uſe in ſmoking tobacco and aloes.

The drawers under this preſs contain a collection of medals, china ink, lachrymatory phials, and the moſt beautiful engraved ſtones of Europe, or an impreſſion of them in wax or ſulphur, counters, cameos, antiques, taliſmans, ancient weights and meaſures, idols, urns, lamps, inſtruments of ſacrifice, and falſe jewels.

Laſt of all, the embraſures of the windows muſt be furniſhed with pictures of ſtone in connected pieces. Here likewiſe, as well as in the embraſures and pannels of the door, may be put tubes hermetically ſealed, containing rare reptiles preſerved in proper liquors.

Animal Kingdom.

The reader will by this time have ſome idea of the prodigious extent of the ſcience of natural hiſtory; ſo extenſive is it, indeed, that the longeſt life is far from being ſufficient to enable us to acquire a perfect knowledge of it: it is important beyond diſpute, becauſe its buſineſs is with the works of God. In all the articles connected with the preſent, as forming particular parts of it, and to which we refer, we have made great uſe of the works of the celebrated Linnæus, who it is well known arranged the three kingdoms into regular ſyſtems, of which botany is the moſt complete. The world in general ſeems to have been moſt diſſatisfied with the animal kingdom: he himſelf, in the courſe of a variety of editions, made many important alterations. Some men of conſiderable note, for example Buffon, have written on this ſubject without any regard to ſyſtematic arrangement. Dr Berkenhout's works on this part of ſcience are very uſeful; in a particular manner, becauſe he tranſlates Latin names, &c. Bomare's new edition of his Natural Hiſtory, in 15 vols. octavo, a work of conſiderable importance, was publiſhed in 1791.

The moſt complete ſyſtem, however, of natural hiſtory which has been yet given to the public, is undoubtedly that of Linnæus, in his *Syſtema Naturæ*, of which a new and improved edition is actually publiſhing by —— Gmeling. A ſhort view of this elaborate work will, we preſume, not be unacceptable to the reader, as it will preſent him, in a very ſmall compaſs, an abſtract of whatever is at preſent known in the ſix firſt claſſes of natural hiſtory.

Class I. *Mammalia.*

Ord.	Gen.	Sp.
Primatis	4	88
Bruta	7	25
Feræ	10	186
Glires	10	129
Pecora	8	90
Bellucæ	4	25
Cete	4	14
7	47	557

Class II. *Aves.*

Ord.	Gen.	Sp.
Accipitus	4	271
Picæ	23	663
Anſeres	13	314
Grallæ	20	326
Gallinæ	10	129
Paſſeres	17	983
6	87	2686

Class III. *Amphibia.*

Ord.	Gen.	Sp.
Reptilia	4	147
Serpentes	6	219
2	10	366

Class IV.

Animal Kingdom.

Class IV. *Pisces.*

Ord.	Gen.	Sp.
Apodes	10	37
Jugulares	6	52
Thoracici	19	452
Abdominales	16	202
Branchioſtegi	10	81
Condropterygii	5	65
6	66	889

Class V. *Inſectæ.*

Ord.	Gen.	Sp.
Coleoptera	55	4048
Hemyptera	14	1464
Lepidoptera	3	2000
Neuroptera	7	174
Hymenoptera	15	1239
Diptera	12	692
Aptera	15	679
7	121	10896

Class VI. *Vermes.*

Ord.	Gen.	Sp.
Inteſtina	21	384
Molluſca	31	438
Teſtacea	36	2525
Zoophita	15	498
Infuſoria	15	191
5	118	4036

In the new French *Encyclopédie par oidre de Matieres*, the editors promiſed to give a deſcription of more than 18,000 plants. Dr Berkenhout, in the laſt edition of his Synopſis, ſays, that in Great Britain and Ireland there are about 54 ſpecies of the mammalia, 230 of birds, 50 of the amphibia, 600 of inſects, 150 of fiſhes, and 1600 ſpecies of plants: but in every claſs he is probably much within the number.

NAT

Natural Philoſophy.

Natural Philoſophy, is commonly defined to be that art or ſcience which conſiders the powers and properties of natural bodies, and their mutual actions on one another. The province of moral philoſophy is the mind of man; its inquiries and reſearches are into the intellectual world. Natural philoſophy, on the other hand, is only concerned with the material part of the creation. The Moraliſt's buſineſs is to inquire into the nature of virtue, the cauſes and effects of vice, to propoſe remedies for it, and to point out the mode of attaining happineſs, which only can be the reſult of virtuous conduct. The Naturaliſt, on the contrary, has nothing to do with ſpirit; his buſineſs is ſolely about body or matter; and he ought to have a ſolid and accurate knowledge of all material ſubſtances, together with their affections and properties; and, if poſſible, he is to inveſtigate the reaſons of ſuch and ſuch appearances.—Indeed, the firſt and principal part of this ſcience is to collect all the manifeſt and ſenſible appearances of things, and reduce them into a body of natural hiſtory. Philoſophy, it has often been ſaid, and it is even now very generally thought, to mean an inquiry into all the cauſes of things; but experience informs us, that though we are acquainted with a good number of effects, we can trace but few of their cauſes; ſo that philoſophy itſelf will really be found to be in general but a collection of facts. Still, however, it differs from natural hiſtory in its appropriated ſenſe; the buſineſs of which is only to obſerve the appearances of natural bodies ſeparately, and from theſe appearances to claſs them with other bodies: natural philoſophy goes farther, and recites the action of two or more bodies of the ſame or different kinds upon one another; and though it can neither inveſtigate nor point out the cauſes of thoſe effects, whatever they are, yet, from mathematical reaſoning combined with experience, it can be demonſtrated, that in ſuch circumſtances ſuch effects muſt always take place. There are evidently two ways of making obſervations on the material world: the firſt is, when we view things nearly as they happen to turn up, without any deſign or intervention of our own; in which way, indeed, no great improvements can be expected in the art, becauſe chance having the direction, only exhibits occaſional or extemporary properties. The other method is, when, after a thorough acquaintance with bodies, we apply them to other bodies equally known, diligently attending to the reſult, and obſerving whether any thing new ariſes. Such ſeems to be in general the nature of our article; nor is it our intention to be much more particular at preſent. We muſt therefore refer our readers reſpectively to thoſe parts of the ſubject, reſpecting which they wiſh for more ſatisfaction and minuter details. The ancient and modern definitions of the word *philoſophy*, together with its origin, as well as the manner of philoſophiſing in former times as well as at preſent, with the gradual improvement of ſcience, particularly natural, we ſhall introduce, we think, more properly under the words Philosophy and Physics We need only add under the preſent article, what however is well known, that natural philoſophy was till lately divided only into four parts, commonly called the *four branches*, viz. 1. Mechanics; 2 Hydroſtatics; 3, Optics; and 4. Aſtronomy; and theſe again are ſub-divided into various parts. Modern diſcoveries have added, however, two more parts to the number, viz. magnetiſm and electricity, whoſe properties and effects, &c. have been wonderfully unfolded of late years.—It is remarkable, that in the Engliſh univerſities theſe two latter branches are never taken notice of in lecturing on natural philoſophy, the old diviſion being ſtill retained, without any mention of theſe two important articles. The reaſon may be, that they are only ſubject to experiment, and not yet reduced to mathematical reaſoning; which is the method of teaching philoſophy in one of thoſe celebrated ſeminaries. Of theſe branches of this extenſive ſcience, it is not our intention to take even a general view in this place. We muſt

Naturalization || Nature.

must therefore refer our readers to each particular article, where they will find them treated at conſiderable length—See *Experimental Philoſophy*.

NATURALIZATION, in law, the act of naturalizing an alien, or putting him into the condition of a natural born ſubject, and intitling him to the rights and privileges thereof. But none can be naturalized unleſs they have received the ſacrament within one month before the bringing in of the bill, and taken the oaths of allegiance and ſupremacy in the preſence of the parliament. A perſon who is naturalized may have lands by deſcent, as heir at law, as well as obtain them by purchaſe; but he is diſabled from being a member of the privy council or parliament; or from holding offices. 7 Jac. I. cap. 2. 12 Will. III. cap. 2. All children born out of the king's dominions, whoſe fathers were or are ſubjects of this kingdom at the time of their birth, are adjudged to be natural born ſubjects of this realm, except children of parents attainted of treaſon, or that are in the actual ſervice of a foreign prince at enmity with us, 4 Geo. II. cap. 21. Every foreign ſeaman, who in time of war ſerves two years on board an Engliſh ſhip, is *ipſo facto* naturalized, 13 Geo. II. cap. 3. And all foreign Proteſtants and Jews, upon their reſiding ſeven years in any of the Britiſh colonies, without being abſent above two months at a time, or ſerving two years in a military capacity there, are upon taking the oaths naturalized to all intents and purpoſes, as if they had been born in this kingdom; and therefore are admiſſible to all ſuch privileges, and no other, as Proteſtants or Jews born in this kingdom are intitled to. See Alien and Denizen.

In France, before the Revolution, naturalization was the king's prerogative; in England it is only done by act of parliament. In the former of thoſe places, before their government was overturned, Swiſs, Savoyards, and Scots, did not require naturalization, being reputed regnicoles, or natives.

NATURALS, among phyſicians, whatever naturally belongs to an animal, in oppoſition to non-naturals. See Non-naturals.

NATURE, according to Mr Boyle, has eight different ſignifications; it being uſed, 1. For the Author of nature, whom the ſchoolmen call *Natura Naturans*, being the ſame with God. 2. By the nature of a thing, we ſometimes mean its eſſence; that is, the attributes which make it what it is, whether the thing be corporeal or not; as when we attempt to define the nature of a fluid, of a triangle, &c. 3. Sometimes we confound that which a man has by nature with what accrues to him by birth; as when we ſay, that ſuch a man is noble by nature. 4 Sometimes we take nature for an internal principle of motion; as when we ſay, that a ſtone by nature falls to the earth. 5. Sometimes we underſtand, by nature, the eſtabliſhed courſe of things. 6. Sometimes we take nature for an aggregate of powers belonging to a body, eſpecially a living one; in which ſenſe phyſicians ſay, that nature is ſtrong, weak, or ſpent; or that, in ſuch or ſuch diſeaſes, nature left to herſelf will perform the cure. 7. Sometimes we uſe the term *nature* for the univerſe, or whole ſyſtem of the corporeal works of God; as when it is ſaid of a phœnix, or chimera, that there is no ſuch thing in nature. 8. Sometimes too, and that moſt commonly, we expreſs by the word *nature* a kind of ſemi-deity, or other ſtrange kind of being. Nature || Naval.

If, ſays the ſame philoſopher, I were to propoſe a notion of nature, leſs ambiguous than thoſe already mentioned, and with regard to which many axioms relating to that word may be conveniently underſtood, I ſhould firſt diſtinguiſh between the univerſal and the particular nature of things. Univerſal nature I would define to be the aggregate of the bodies that make up the world in its preſent ſtate, conſidered as a principle; by virtue whereof they act and ſuffer, according to the laws of motion preſcribed by the Author of all things. And this makes way for the other ſubordinate notion; ſince the particular nature of an individual conſiſts in the general nature applied to a diſtinct portion of the univerſe; or, which is the ſame thing, it is a particular aſſemblage of the mechanical properties of matter, as figure, motion, &c.

Kingdoms of Nature. See Kingdoms.

Conduct or Operations of Nature. See *Natural Hiſtory*.

NAVA, (anc. geog.) Tacitus; a river of Belgica, which runs north-eaſt into the left or weſt ſide of the Rhine. Now the *Nahe*, riſing at the village Naheweiler, on the borders of the biſhopric of Triers, running through the Lower Palatinate, the duchy of Simmeren, by the ſmall town of Bing, into the Rhine.

NAVAL, ſomething relating to a ſhip; whence,

Naval Architecture. See *Ship-Building*.

Naval-Camp, in antiquity, a fortification, conſiſting of a ditch and parapet on the land ſide, or a wall built in the form of a ſemicircle, and extended from one point of the ſea to another. This was ſometimes defended with towers, and beautified with gates, through which they iſſued forth to attack their enemies. Homer hath left us a remarkable deſcription of the Grecian fortifications of this ſort, in the Trojan war, beginning at v. 436. Iliad ν.

Then, to ſecure the camp and naval powers,
They rais'd embattled walls with lofty tow'rs:
From ſpace to ſpace were ample gates around,
For paſſing chariots; and a trench profound,
Of large extent; and deep in earth below
Strong piles infix'd ſtood adverſe to the foe.
Pope's *Tranſl.*

Towards the ſea, or within it, they fixed great pales of wood, like thoſe in their artificial harbours; before theſe the veſſels of burden were placed in ſuch order, as that they might be inſtead of a wall, and give protection to thoſe within; in which manner Nicias is reported by Thucydides to have encamped himſelf: but this ſeems only to have been practiſed when the enemy was thought ſuperior in ſtrength, and raiſed great apprehenſions of danger in them. When their fortifications were thought ſtrong enough to defend them from the aſſaults of enemies, it was frequent to drag their ſhips to ſhore, which the Greeks called ἑναλκειν, the Romans *ſubducere*. Around the ſhips the ſoldiers diſpoſed their tents, as appears every where in Homer: but this ſeems only to have been practiſed in winter, when their enemy's fleet was laid up and could not aſſault them; or in long ſieges, and when they lay in no danger from their enemies by ſea;

Navan, Navarre.

as in the Trojan war, where the defenders of Troy never once attempted to encounter the Grecians in a ſea-fight.

The adjacent places were uſually filled with inns and ſtews, well ſtocked with females, that proſtituted themſelves to the mariners, merchants, and artificers of all ſorts, who flocked thither in great numbers; this, however, appears to have happened only in times of peace.

Naval-Crown, among the ancient Romans, a crown adorned with figures of prows of ſhips, conferred on perſons who in ſea-engagements firſt boarded the enemy's veſſel. See Crown.

Naval-Engagement. See Tactics *(Naval)*.

Naval Stores, comprehend all thoſe particulars made uſe of, not only in the royal navy, but in every other kind of navigation; as timber and iron for ſhipping, pitch, tar, hemp, cordage, ſail-cloth, gunpowder, ordnance, and fire-arms of every ſort, ſhip-chandlery wares, &c.

Naval-Tactics, the military operations of fleets. See Tactics *(Naval)*.

NAVAN, a borough, poſt, and fair town of Ireland, in the county of Meath and province of Leinſter; ſituated about 23 miles north-weſt of Dublin, on the river Boyne. It conſiſts of two chief ſtreets, which interſect each other at right angles.—The Tholſel, or town-houſe, is a handſome ſtone-building. This place was formerly in great repute, and walled in by Hugh de Lacy. An abbey for regular cannons, dedicated to the Virgin Mary, was erected here; but whether antecedent to the end of the 12th century is not certain: about that period, however, it was either founded or re-edified by Joceline de Angulo or Nangle. In the burial-ground are the remains of many ancient tombs, with figures in alto relievo; and the preſent barrack for one troop of horſe is built on the ſite of the abbey. Navan ſends two members to parliament; patronage in the Preſton family. Here are four fairs held.

NAVARRE, a province of Spain, part of the ancient kingdom of Navarre, erected ſoon after the invaſion of the Moors; and is otherwiſe called *Upper Navarre*, to diſtinguiſh it from Lower Navarre belonging to the French. It is bounded on the ſouth and eaſt by Arragon, on the north by the Pyrenees, and on the weſt by Old Caſtile and Biſcay; extending from ſouth to north about 80 miles, and from eaſt to weſt about 75. It abounds in ſheep and cattle; game of all kinds, as boars, ſtags, and roebucks; and in wild-fowl, horſes, and honey; yielding alſo ſome grain, wine, oil, and a variety of minerals, medicinal waters, and hot baths. Some of the ancient chiefs of this country were called *Sobrarbores*, from the cuſtom, as it is ſuppoſed, which prevailed among ſome of thoſe free nations of chooſing and ſwearing their princes under ſome particular tree. The name of the province is ſuppoſed to be a contraction of *Nava Errea*, ſignifying, in the language of the Vaſcones, its ancient inhabitants, "a land of valleys."—For the particulars of its hiſtory, ſee the article Spain.

Navarre (Peter), an officer of eminence in the 16th century, and particularly celebrated for his dexterity in the directing and ſpringing of mines. He was a native of Biſcay and of low extraction. According to Paul Jove, who affirms that he had an account of the matter from his own mouth, he was firſt a ſailor; but being diſguſted with that employment, he ſought his fortune in Italy, when poverty compelled him to become footman to the cardinal of Arragon. He afterwards inliſted himſelf a ſoldier in the Houſtine army; and having ſerved there for ſome time, went to ſea again, and diſtinguiſhed himſelf by his courage. The reputation of his valour having reached the ears of Gonſalvo de Cordoue, this general employed him in the war againſt Naples, and raiſed him to the rank of a captain. Having contributed greatly to the taking of that city by very opportunely ſpringing a mine, the emperor rewarded him for this ſignal ſervice with the earldom of Alveto, ſituated in that kingdom, and gave him the title of *count of Navarre*. Having the command of a naval expedition againſt the Moors in Africa, he was at firſt very ſucceſsful, and took poſſeſſion of Oran, Tripoli, and ſome other places; but being afterwards ſhipwrecked on the iſland of Gerbes, the great heats and the Mooriſh cavalry deſtroyed a part of his army. Our hero was equally unfortunate in Italy: He was made priſoner at the famous battle of Ravenna, in 1512, and languiſhed in France for the ſpace of two years. When finding that the king of Spain, who had been prejudiced againſt him by his courtiers, would do nothing towards his ranſom, he went into the ſervice of Francis I. who gave him the command of twenty companies of infantry, conſiſting of Gaſcons, Biſcayans, and the inhabitants of the Pyrenee mountains. He diſtinguiſhed himſelf in ſeveral ſucceſsful expeditions, until the year 1522, when having been ſent to the relief of the Genoeſe, he was taken by the Imperialiſts. They conducted him to Naples, where he remained a priſoner for three years in the caſtle of Œuf. From this confinement he was releaſed by the treaty of Madrid, and afterwards fought at the ſiege of Naples under Laulric in 1528: but being again made priſoner at the unfortunate retreat from Averſa, he was conducted a ſecond time to the caſtle of Œuf. Here the prince of Orange having, by order of the emperor, cauſed ſeveral perſons of the *Angevine* faction to be beheaded, our hero would undoubtedly have ſuffered the ſame fate, if the governor, ſeeing his diſtreſſed ſituation, and feeling for the misfortunes of ſo great a man, had not ſaved him the ſhame of this laſt puniſhment by allowing him to die a natural death. Others pretend that he was ſtrangled in his bed, having arrived at a very advanced age. Paul Jove and Philip Thomaſini have written his life. This laſt informs us, that he was of a tall ſize, had a ſwarthy countenance, black eyes, beard, and hair. A duke of Seſſa, in the laſt century, being deſirous to honour his memory and that of the marſhal de Lautree, cauſed a monument to be erected to each of them in the church of Sainte-Marie-le-Neuve at Naples, where they had been interred without any funeral honours.

Navarre (ſurnamed Martin Azpilcueta), becauſe he was born in the kingdom which bears that name, ſucceſſively profeſſor of juriſprudence at Toulouſe, Salamanca, and Coimbra, was conſulted from all quarters as the oracle of law. For a part of his knowledge he was indebted to the ſchools of Cahors and Toulouſe,

Navarre.

Nauclerus || Naucratites.

in which he had ſtudied. His friend Barthelemi Carewza, a Dominican, and archbiſhop of Toledo, having been charged with hereſy by the court of Inquiſition at Rome, Navarre ſet out at the age of 80 years to defend him. Pius V. appointed him aſſeſſor to cardinal Francis Alciat, vice-penetentiary. Gregory XIII. never paſſed his gate without ſending for him; and ſometimes would converſe with him for an hour together on the ſtreet: he even deigned to viſit him, accompanied by ſeveral cardinals. Theſe honours did not render him more haughty. His character became ſo eminent, that even in his own time the greateſt encomium that could be paid to a man of learning was to ſay that he was a *Navarre:* this name thus included the idea of erudition, as that of Roſcius formerly marked an accompliſhed comedian. Azpilcueta was the oracle of the city of Rome, and of the whole Chriſtian world. For the influence which he had acquired, he was indebted not only to his knowledge, but alſo to his probity and virtue. Faithful to the duties which the church preſcribed, his temperance and frugality preſerved to him a vigorous conſtitution; and at a very advanced age his genius was equal to the ſevereſt ſtudy. His ſavings enabled him to give liberal aſſiſtance to the poor. His charities, indeed, were ſo great, that his mule, it is ſaid, would ſtop as ſoon as ſhe perceived a beggar. He died at Rome in 1586, at the age of 92. His works were collected and printed in 6 vols folio at Lyons in 1597, and at Venice in 1602. They diſplay more learning than judgement, and are now very ſeldom conſulted. Navarre was uncle by the mother's ſide to St Francis of Sales. See SALES.

NAUCLERUS (John), deſcended of a noble family of Suabia, was provoſt of the church of Suringia, and profeſſor of law in the univerſity of that city.—His original name was *Vergeau;* but this name, which in German ſignifies "ſailor," he changed into Nauclerus, a word of the ſame ſignification in Greek.—He was alive in 1501. We have from him a Latin Chronicle from Adam to the year 1500, of which Baſelius wrote a continuation down to 1514, and Surius to 1564. It poſſeſſes greater accuracy than any hiſtorical compilation which had appeared prior to his time; but ſtill it is only a compilation. It is chiefly valued for what regards the occurrences of the 15th century. It was printed at Cologne in folio in 1564 and 1579.

NAUCRARI, among the Athenians, was the name given to the chief magiſtrates of the Δημοι, "boroughs or townſhips," called Ναυκραριαι; becauſe each was obliged, beſides two horſemen, to furniſh out one ſhip for the public ſervice.

NAUCRATES, a Greek poet, who was employed by Artemiſia to write a panegyric upon Mauſolus.—An orator who endeavoured to alienate the cities of Lycia from the intereſt of Brutus.

NAUCRATIS, a city of Egypt on the left ſide of the Canopic mouth of the Nile. It was celebrated for its commerce, and no ſhip was permitted to land at any other place, but was obliged to ſail directly to the city, there to depoſit its cargo. It gave birth to Athenæus.

NAUCRATITES Nomos (anc. geog.), Pliny; a diviſion of the Delta, ſo called from the town *Naucratis;* though Ptolemy compriſes it under the Nomos Saites.

Naucides, Naude.

NAUCYDES, a ſtatuary who lived about four centuries before the Chriſtian era.

NAUDE (Gabriel), was deſcended of a reputable family, and born at Paris, February 12th, 1600.—His parents obſerving his fondneſs for reading and inclination to letters, reſolved to breed him in that way; and accordingly ſent him to a religious community, to learn the firſt rudiments of grammar and the principles of Chriſtianity. Thence he was removed to the univerſity, where he applied himſelf with great ſucceſs to claſſical learning; and having learned philoſophy, was created maſter of arts very young.—As ſoon as he had finiſhed his courſe in philoſophy, he remained ſome time at a ſtand what profeſſion to chooſe, being adviſed by his friends to divinity; but his inclination being more turned to phyſic, he fixed at length upon that faculty. However, this choice did not prevent him from indulging his genius in other branches of learning: in reality, the plan of his ſtudies was very extenſive, ſuited to his comprehenſive talents and indefatigable induſtry: and he ſoon diſtinguiſhed himſelf therein ſo much, that Henry de Meſmes, preſident à mortier, hearing his character, made him keeper of his library, and took him into his family. Naude was the more pleaſed with this poſt, as it gave him an opportunity of gratifying his bookiſh taſte in general, and at the ſame time furniſhed him both with means and leiſure to improve himſelf as he could wiſh, in the ſcience which he had embraced in particular. He quitted it in 1626, in order to go to Padua to perfect himſelf therein: but he did not continue long in that univerſity, the death of his father and his domeſtic affairs calling him back to Paris before the expiration of the year.

In 1628 the faculty of phyſic appointed him to make the cuſtomary diſcourſe on the reception of licentiates; which performance entirely anſwered their expectations from him, and was made public. In 1631, Cardinal Bagni made him his librarian and Latin ſecretary, and carried him with him to Rome in the ſpring of that year. Naude continued in this ſervice till the death of the cardinal, which happened July 24. 1641; and in the interim made an excurſion to Padua, to take his doctor of phyſic's degree, in order to ſupport with a better grace the quality with which he had been honoured by Louis XIII. who had made him his phyſician. The ceremony of this appointment was performed March 25. 1633, and we have the ſpeech he pronounced on the occaſion. After the death of his patron, he had thoughts of returning to France; but was detained in Italy by ſeveral advantageous offers made to him by perſons of conſideration in that country. Among theſe he preferred thoſe of Cardinal Barberini, and cloſed with his eminence. However, as ſoon as Cardinal Richelieu ſent for him to be his librarian, he immediately returned to Paris; but he happened not to be long in the ſervice of the prime miniſter, if it be true that he arrived at Paris in March 1642, ſince Cardinal Richelieu died in December following: notwithſtanding, he ſucceeded to the like poſt under Mazarine, for whom he

Naude. formed a moſt rich library, which he raiſed from the firſt volume in the ſpace of ſeven years to the number of 40,000.

His deſign was nearly completed before the Cardinal gave him two ſmall benefices, a canonry of Verdun and the priory of Artige in the Limoſin: and we know how much this ungenerosity affected him, from a letter of Patin to Charles Spon, dated March 22. 1648, where he writes thus of our librarian: "I have ſeen one thing in him which I am very ſorry for; eſpecially as I have known him all along hitherto at a great diſtance from ſuch a diſpoſition: it is, that he begins to complain of his fortune, and of his maſter's avarice, from whom he had never received any more than 1200 livres a year in benefices; not forbearing to declare, that his life was ſacrificed for too ſmall a matter. I think (continues Patin) what grieves him is, the apprehenſion of dying before he has raiſed ſomething for his brothers and his nephews, of whom he has a great number." However that be, Naude had the grief to ſee this library, which he had collected with ſo much pains and care, totally diſperſed. Upon the diſgrace of Mazarine it was ſold; and Patin, in a letter of March 5. 1651, obſerves, that Naude had bought all the books in phyſic for 3500 livres Chriſtina queen of Sweden, who ſet herſelf to draw into her dominions all the literati of Europe, procured a propoſal to be made to Naude of being her library keeper; and as he was then out of all employ, he accepted the propoſal, and went to Cop.—But he ſoon grew out of humour with his reſidence in Sweden: the manners of the people, ſo very different from his, gave him great diſguſt; and ſeeing France become more quiet than it had been, he reſolved to return. Accordingly he quitted Sweden loaded with preſents from the queen, and ſeveral perſons of diſtinction: but the fatigue of the journey threw him into a fever, which obliged him to ſtop at Abbeville; and he died there July 29. 1653. Nave ‖ Navew.

As to his character, he was very prudent and regular in his conduct, ſober, never drinking any thing but water. Study was his principal occupation, and he was indeed a true *Helluo librorum*; ſo that he underſtood them perfectly well. He ſpoke his mind with great freedom, and that freedom ſometimes ſhowed itſelf upon religious ſubjects, in ſuch a manner as might have occaſioned ſome diſadvantageous thoughts of him; but the Chriſtian ſentiments in which he died left room to believe that his heart was never corrupted, and had no ſhare in the free expreſſions which ſometimes eſcaped from him; eſpecially in the philoſophical railleries which paſſed ſometimes between him, Guy Patin, and Gaſſendi. He wrote a great number of books, a catalogue of which may be ſeen in Niceron's Memoires, tom. ix. Voltaire ſays, that "of all his books, the *Apologie des grands Hommes accuſés de Magie* is almoſt the only one which continues to be read."

NAVE, in architecture, the body of a church, where the people are diſpoſed, reaching from the balluſter, or rail of the door, to the chief choir. Some derive the word from the Greek ναος, "a temple;" and others from ναυς, "a ſhip," by reaſon the vault or roof of a church bears ſome reſemblance to a ſhip.

NAVEL, in anatomy, the centre of the lower part of the abdomen; being that part where the umbilical veſſels paſſed out of the placenta of the mother. See Anatomy, p. 725.

Navel-Wort, in botany. See Cotyledon.

NAVEW, in botany. See Brassica, of which it is a ſpecies.

NAVIGATION,

IS the art of conducting or carrying a ſhip from one port to another.

HISTORY.

The poets refer the invention of the art of navigation to Neptune, ſome to Bacchus, others to Hercules, others to Jaſon, and others to Janus, who is ſaid to have made the firſt ſhip. Hiſtorians aſcribe it to the Æginets, the Phœnicians, Tyrians, and the ancient inhabitants of Britain. Some will have it, the firſt hint was taken from the flight of the kite; others, as Oppian, (*De piſcibus*, lib. i.) from the fiſh called *nautilus*: others aſcribe it to accident.—Scripture refers the origin of ſo uſeful an invention to God himſelf, who gave the firſt ſpecimen thereof in the ark built by Noah under his direction. For the raillery the good man underwent on account of his enterpriſe ſhows evidently enough the world was then ignorant of any thing like navigation, and that they even thought it impoſſible.

However, profane hiſtory repreſents the Phœnicians, eſpecially thoſe of their capital Tyre, as the firſt navigators; being urged to ſeek a foreign commerce by the narrowneſs and poverty of a ſlip of ground they poſſeſſed along the coaſts; as well as by the conveniency of two or three good ports, and by their natural genius to traffic. Accordingly, Lebanon, and the other neighbouring mountains, furniſhing them with excellent wood for ſhip-building, in a ſhort time they were maſters of a numerous fleet; and conſtantly hazarding new navigations, and ſettling new trades, they ſoon arrived at an incredible pitch of opulency and populouſneſs: inſomuch as to be in a condition to ſend out colonies, the principal of which was that of Carthage; which, keeping up their Phœnician ſpirit of commerce, in time not only equalled Tyre itſelf, but vaſtly ſurpaſſed it; ſending its merchant-fleets through Hercules's pillars, now the ſtraits of Gibraltar, along the weſtern coaſts of Africa and Europe; and even, if we believe ſome authors, to America itſelf.

Tyre, whoſe immenſe riches and power are repreſented in ſuch lofty terms both in ſacred and profane authors, being deſtroyed by Alexander the Great, its navigation and commerce were transferred by the conqueror to Alexandria, a new city, admirably ſituated for thoſe purpoſes; propoſed for the capital of the empire of Aſia, which Alexander then meditated.

And thus aroſe the navigation of the Egyptians; which was afterwards ſo cultivated by the Ptolemies, that Tyre and Carthage were quite forgotten.

Egypt being reduced into a Roman province after the battle of Actium, its trade and navigation fell into the hands of Auguſtus; in whoſe time Alexandria was only inferior to Rome: and the magazines of the capital of the world were wholly ſupplied with merchandizes from the capital of Egypt.

At length, Alexandria itſelf underwent the fate of Tyre and Carthage; being ſurpriſed by the Saracens, who, in ſpite of the emperor Heraclius, overſpread the northern coaſts of Africa, &c. whence the merchants being driven, Alexandria has ever ſince been in a languiſhing ſtate, though it ſtill has a conſiderable part of the commerce of the Chriſtian merchants trading to the Levant.

The fall of Rome and its empire drew along with it not only that of learning and the polite arts, but that of navigation; the barbarians, into whoſe hands it fell, contenting themſelves with the ſpoils of the induſtry of their predeceſſors.

But no ſooner were the more brave among thoſe nations well ſettled in their new provinces; ſome in Gaul, as the Franks; others in Spain, as the Goths; and others in Italy, as the Lombards; but they began to learn the advantages of navigation and commerce, and the methods of managing them, from the people they ſubdued; and this with ſo much ſucceſs, that in a little time ſome of them became able to give new leſſons, and ſet on foot new inſtitutions for its advantage. Thus it is to the Lombards we uſually aſcribe the invention and uſe of banks, book-keeping, exchanges, rechanges, &c.

It does not appear which of the European people, after the ſettlement of their new maſters, firſt betook themſelves to navigation and commerce.—Some think it began with the French; though the Italians ſeem to have the juſteſt title to it; and are accordingly ordinarily looked on as the reſtorers thereof, as well as of the polite arts, which had been baniſhed together from the time the empire was torn aſunder. It is the people of Italy then, and particularly thoſe of Venice and Genoa, who have the glory of this reſtoration; and it is to their advantageous ſituation for navigation they in great meaſure owe their glory. In the bottom of the Adriatic were a great number of marſhy iſlands, only ſeparated by narrow channels, but thoſe well ſcreened, and almoſt inacceſſible, the reſidence of ſome fiſhermen, who here ſupported themſelves by a little trade of fiſh and ſalt, which they found in ſome of theſe iſlands. Thither the Veneti, a people inhabiting that part of Italy along the coaſts of the gulph, retired, when Alaric king of the Goths, and afterwards Attila king of the Huns, ravaged Italy.

Theſe new iſlanders, little imagining that this was to be their fixed reſidence, did not think of compoſing any body politic; but each of the 72 iſlands of this little Archipelago continued a long time under its ſeveral maſters, and each made a diſtinct commonwealth. When their commerce was become conſiderable enough to give jealouſy to their neighbours, they began to think of uniting into a body. And it was this union, firſt begun in the ſixth century, but not completed till the eighth, that laid the ſure foundation of the future grandeur of the ſtate of Venice. From the time of this union, their fleets of merchantmen were ſent to all the parts of the Mediterranean; and at laſt to thoſe of Egypt, particularly Cairo, a new city, built by the Saracen princes on the eaſtern banks of the Nile, where they traded for their ſpices and other products of the Indies. Thus they flouriſhed, increaſed their commerce, their navigation, and their conqueſts on the terra firma, till the league of Cambray in 1508, when a number of jealous princes conſpired to their ruin; which was the more eaſily effected by the diminution of their Eaſt-India commerce, of which the Portugueſe had got one part and the French another. Genoa, which had applied itſelf to navigation at the ſame time with Venice, and that with equal ſucceſs, was a long time its dangerous rival, diſputed with it the empire of the ſea, and ſhared with it the trade of Egypt and other parts both of the eaſt and weſt.

Jealouſy ſoon began to break out; and the two republics coming to blows, there was almoſt continual war for three centuries before the ſuperiority was aſcertained; when, towards the end of the 14th century, the battle of Chioza ended the ſtrife: the Genoeſe, who till then had uſually the advantage, having now loſt all; and the Venetians, almoſt become deſperate, at one happy blow, beyond all expectation, ſecured to themſelves the empire of the ſea, and ſuperiority in commerce.

About the ſame time that navigation was retrieved in the ſouthern parts of Europe, a new ſociety of merchants was formed in the north, which not only carried commerce to the greateſt perfection it was capable of till the diſcovery of the Eaſt and Weſt Indies, but alſo formed a new ſcheme of laws for the regulation thereof, which ſtill obtain under the names of *Uſes and Cuſtoms of the Sea*. This ſociety is that famous league of the Hanſe-towns, commonly ſuppoſed to have begun about the year 1164. See *Hanse Towns*.

For the modern ſtate of navigation in England, Holland, France, Spain, Portugal, &c. See Commerce, Company, &c.

We ſhall only add, that, in examining the reaſons of commerce's paſſing ſucceſſively from the Venetians, Genoeſe, and Hanſe-towns, to the Portugueſe and Spaniards, and from theſe again to the Engliſh and Dutch, it may be eſtabliſhed as a maxim, that the relation between commerce and navigation, or, if we may be allowed to ſay it, their union is ſo intimate, that the fall of the one inevitably draws after it that of the other; and that they will always either flouriſh or dwindle together. Hence ſo many laws, ordinances, ſtatutes, &c. for its regulation; and hence particularly that celebrated act of navigation, which an eminent foreign author calls the *palladium* or *tutelar deity of the commerce of England*; which is the ſtanding rule, not only of the Britiſh among themſelves, but alſo of other nations with whom they traffic.

The art of navigation hath been exceedingly improved in modern times, both with regard to the form of the veſſels themſelves, and with regard to the methods of working them. The uſe of rowers is now entirely ſuperſeded by the improvements made in the formation of the ſails, rigging, &c. by which means

the ſhips can not only ſail much faſter than formerly, but can tack in any direction with the greateſt facility. It is alſo very probable that the ancients were neither ſo well ſkilled in finding the latitudes, nor in ſteering their veſſels in places of difficult navigation, as the moderns. But the greateſt advantage which the moderns have over the ancients is from the mariner's compaſs, by which they are enabled to find their way with as great facility in the midſt of an immeaſurable ocean, as the ancients could have done by creeping along the coaſt, and never going out of ſight of land. Some people indeed contend, that this is no new invention, but that the ancients were acquainted with it. They ſay, that it was impoſſible for Solomon to have ſent ſhips to Ophir, Tarſhiſh, and Parvaim, which laſt they will have to be *Peru*, without this uſeful inſtrument. They inſiſt, that it was impoſſible for the ancients to be acquainted with the attractive virtue of the magnet, and to be ignorant of its polarity. Nay, they affirm, that this property of the magnet is plainly mentioned in the book of Job, where the loadſtone is mentioned by the name of *topaz*, or *the ſtone that turns itſelf*. But it is certain, that the Romans, who conquered Judæa, were ignorant of this inſtrument; and it is very improbable, that ſuch an uſeful invention, if once it had been commonly known to any nation, would have been forgot, or perfectly concealed from ſuch a prudent people as the Romans, who were ſo much intereſted in the diſcovery of it.

Among thoſe who do agree that the mariner's compaſs is a modern invention, it hath been much diſputed who was the inventor. Some give the honour of it to Flavio Gioia of Amalfi in Campania*, who lived about the beginning of the 14th century; while others ſay that it came from the eaſt, and was earlier known in Europe. But, at whatever time it was invented, it is certain, that the mariner's compaſs was not commonly uſed in navigation before the year 1420. In that year the ſcience was conſiderably improved under the auſpices of Henry duke of Viſco, brother to the king of Portugal. In the year 1485, Roderic and Joſeph, phyſicians to John II. king of Portugal, together with one Martin de Bohemia, a Portugueſe, native of the iſland of Fayal, and ſcholar to Regiomontanus, calculated tables of the ſun's declination for the uſe of ſailors, and recommended the aſtrolabe for taking obſervations at ſea. Of the inſtructions of Martin, the celebrated Chriſtopher Columbus is ſaid to have availed himſelf, and to have improved the Spaniards in the knowledge of the art; for the farther progreſs of which a lecture was afterwards founded at Seville by the emperor Charles V.

* See *Mariner's Compaſs.*

The diſcovery of the variation is claimed by Columbus, and by Sebaſtian Cabot. The former certainly did obſerve this variation without having heard of it from any other perſon, on the 14th of September 1492, and it is very probable that Cabot might do the ſame. At that time it was found that there was no variation at the Azores, where ſome geographers have thought proper to place the firſt meridian; though it hath ſince been obſerved that the variation alters in time.—The uſe of the croſs-ſtaff now began to be introduced among ſailors. This ancient inſtrument is deſcribed by John Werner of Nuremberg, in his annotations on the firſt book of Ptolemy's Geography, printed in 1514. He recommends it for obſerving the diſtance between the moon and ſome ſtar, in order thence to determine the longitude.

At this time the art of navigation was very imperfect on account of the inaccuracies of the plane chart, which was the only one then known, and which, by its groſs errors, muſt have greatly miſled the mariner, eſpecially in voyages far diſtant from the equator. Its precepts were probably at firſt only ſet down on the ſea-charts, as is the cuſtom at this day: but at length there were two Spaniſh treatiſes publiſhed in 1545; one by Pedro de Medina; the other by Martin Cortes, which contained a complete ſyſtem of the art, as far as it was then known. Theſe ſeem to have been the oldeſt writers who fully handled the art; for Medina, in his dedication to Philip prince of Spain, laments that multitudes of ſhips daily periſhed at ſea, becauſe there were neither teachers of the art, nor books by which it might be learned; and Cortes, in his dedication, boaſts to the emperor, that he was the firſt who had reduced navigation into a compendium, valuing himſelf much on what he had performed. Medina defended the plane chart; but he was oppoſed by Cortes, who ſhowed its errors, and endeavoured to account for the variation of the compaſs, by ſuppoſing the needle to be influenced by a magnetic pole (which he called the *point attractive*) different from that of the world: which notion hath been farther proſecuted by others. Medina's book was ſoon tranſlated into Italian, French, and Flemiſh, and ſerved for a long time as a guide to foreign navigators. However, Cortes was the favourite author of the Engliſh nation, and was tranſlated in 1561; while Medina's work was entirely neglected, though tranſlated alſo within a ſhort time of the other. At that time the ſyſtem of navigation conſiſted of the following particulars, and others ſimilar: An account of the Ptolemaic hypotheſis, and the circles of the ſphere; of the roundneſs of the earth, the longitudes, latitudes, climates, &c and eclipſes of the luminaries; a kalendar; the method of finding the prime, epact, moon's age, and tides; a deſcription of the compaſs, an account of its variation, for the diſcovering of which Cortes ſaid an inſtrument might eaſily be contrived; tables of the ſun's declination for four years, in order to find the latitude from his meridian altitude; directions to find the ſame by certain ſtars; of the courſe of the ſun and moon; the length of the days; of time and its diviſions; the method of finding the hour of the day and night; and laſtly, a deſcription of the ſea-chart, on which to diſcover where the ſhip is, they made uſe of a ſmall table, that ſhowed, upon an alteration of one degree of the latitude, how many leagues were run in each rhumb, together with the departure from the meridian. Beſides, ſome inſtruments were deſcribed, eſpecially by Cortes; ſuch as one to find the place and declination of the ſun, with the days, and place of the moon; certain dials, the aſtrolabe, and croſs-ſtaff; with a complex machine to diſcover the hour and latitude at once.

About the ſame time were made propoſals for finding the longitude by obſervations of the moon.—In 1530, Gemma Friſius adviſed the keeping of the time by means of ſmall clocks or watches, then, as he ſays, newly invented. He alſo contrived a new ſort of

of croſs-ſtaff and an inſtrument called the *nautical quadrant*; which laſt was much praiſed by William Cuningham, in his *Aſtronomical Glaſs*, printed in the year 1559.

In 1537 Pedro Nunez, or Nonius, publiſhed a book in the Portugueſe language, to explain a difficulty in navigation propoſed to him by the commander Don Martin Alphonſo de Suſa. In this he expoſes the errors of the plane chart, and likewiſe gives the ſolution of ſeveral curious aſtronomical problems; amongſt which is that of determining the latitude from two obſervations of the ſun's altitude and intermediate azimuth being given. He obſerved, that though the rhumbs are ſpiral lines, yet the direct courſe of a ſhip will always be in the arch of a great circle, whereby the angle with the meridians will continually change: all that the ſteerſman can here do for the preſerving of the original rhumb, is to correct theſe deviations as ſoon as they appear ſenſible. But thus the ſhip will in reality deſcribe a courſe without the rhumb-line intended; and therefore his calculations for aſſigning the latitude, where any rhumb-line croſſes the ſeveral meridians, will be in ſome meaſure erroneous. He invented a method of dividing a quadrant by means of concentric circles, which, after being much improved by Dr Halley, is uſed at preſent, and is called a *nonius*.

In 1577, Mr William Bourne publiſhed a treatiſe, in which, by conſidering the irregularities in the moon's motion, he ſhows the errors of the ſailors in finding her age by the epact, and alſo in determining the hour from obſerving on what point of the compaſs the ſun and moon appeared. He adviſes, in ſailing towards the high latitudes, to keep the reckoning by the globe, as there the plane chart is moſt erroneous. He deſpairs of our ever being able to find the longitude, unleſs the variation of the compaſs ſhould be occaſioned by ſome ſuch attractive point, as Cortes had imagined; of which, however, he doubts: but as he had ſhown how to find the variation at all times, he adviſes to keep an account of the obſervations, as uſeful for finding the place of the ſhip; which advice was proſecuted at large by Simon Stevin, in a treatiſe publiſhed at Leyden in 1599; the ſubſtance of which was the ſame year printed at London in Engliſh by Mr Edward Wright, intitled the *Haven finding Art*. In this ancient tract alſo is deſcribed the way by which our ſailors eſtimate the rate of a ſhip in her courſe, by an inſtrument called the *log*. This was ſo named from the piece of wood or log that floats in the water while the time is reckoned during which the line that is faſtened to it is veering out. The author of this contrivance is not known; neither was it taken notice of till 1607, in an Eaſt India voyage publiſhed by Purchas: but from this time it became famous, and was much taken notice of by almoſt all writers on navigation in every country; and it ſtill continues to be uſed as at firſt, though many attempts have been made to improve it, and contrivances propoſed to ſupply its place; many of which have ſucceeded in quiet water, but proved uſeleſs in a ſtormy ſea.

In 1581 Michael Coignet, a native of Antwerp, publiſhed a treatiſe, in which he animadverted on Medina. In this he ſhowed, that as the rhumbs are ſpirals, making endleſs revolutions about the poles, numerous errors muſt ariſe from their being repreſented by ſtraight lines on the ſea-charts; but though he hoped to find a remedy for theſe errors, he was of opinion that the propoſals of Nonius were ſcarcely practicable, and therefore in a great meaſure uſeleſs. In treating of the ſun's declination, he took notice of the gradual decreaſe in the obliquity of the ecliptic; he alſo deſcribed the croſs-ſtaff with three tranſverſe pieces, as it is at preſent made, and which he owned to have been then in common uſe among the ſailors. He likewiſe gave ſome inſtruments of his own invention; but all of them are now laid aſide, excepting perhaps his nocturnal. He conſtructed a ſea-table to be uſed by ſuch as ſailed beyond the 60th degree of latitude; and at the end of the book is delivered a method of ſailing on a parallel of latitude by means of a ring dial and a 24 hour-glaſs. The ſame year the diſcovery of the dipping-needle was made by Mr Robert Norman*. In his publication on that art he maintains, in oppoſition to Cortes, that the variation of the compaſs was cauſed by ſome point on the ſurface of the earth, and not in the heavens: he alſo made conſiderable improvements in the conſtruction of compaſſes themſelves; ſhowing eſpecially the danger of not fixing, on account of the variation, the wire directly under the *flower-de-luce*; as compaſſes made in different countries have it placed differently. To this performance of Norman's is always prefixed a diſcourſe on the variation of the magnetical needle, by Mr William Burrough, in which he ſhows how to determine the variation in many different ways. He alſo points out many errors in the practice of navigation at that time, and ſpeaks in very ſevere terms concerning thoſe who had publiſhed upon it.

* See *Dipping-needle.*

All this time the Spaniards continued to publiſh treatiſes on the art. In 1585 an excellent compendium was publiſhed by Roderico Zamorano; which contributed greatly towards the improvement of the art, particularly in the ſea charts. Globes of an improved kind, and of a much larger ſize than thoſe formerly uſed, were now conſtructed, and many improvements were made in other inſtruments; however, the plane chart continued ſtill to be followed, though its errors were frequently complained of. Methods of removing theſe errors had indeed been ſought after; and Gerard Mercator ſeems to have been the firſt who found the true method of doing this ſo as to anſwer the purpoſes of ſeamen. His method was to repreſent the parallels both of latitude and longitude by parallel ſtraight lines, but gradually to augment the former as they approached the pole. Thus the rhumbs, which otherwiſe ought to have been curves, were now alſo extended into ſtraight lines; and thus a ſtraight line drawn between any two places marked upon the chart would make an angle with the meridians, expreſſing the rhumb leading from the one to the other. But though, in 1569, Mercator publiſhed an univerſal map conſtructed in this manner, it doth not appear that he was acquainted with the principles on which this proceeded; and it is now generally believed, that the true principles on which the conſtruction of what is called *Mercator's chart* depends, were firſt diſcovered by an Engliſhman, Mr Edward Wright.

Mr Wright ſuppoſes, but, according to the general opinion, without ſufficient grounds, that this enlargement of the degrees of latitude was known and mentioned by Ptolemy, and that the ſame thing had alſo been ſpoken of by Cortes. The expreſſions of Ptolemy

lemy alluded to, relate indeed to the proportion between the diſtances of the parallels and meridians; but inſtead of propoſing any gradual enlargement of the parallels of latitude, in a general chart, he ſpeaks only of particular maps; and adviſes not to confine a ſyſtem of ſuch maps to one and the ſame ſcale, but to plan them out by a different meaſure, as occaſion might require: only with this precaution, that the degrees of longitude in each ſhould bear ſome proportion to thoſe of latitude; and this proportion is to be deduced from that which the magnitude of the reſpective parallels bear to a great circle of the ſphere. He adds, that in particular maps, if this proportion be obſerved with regard to the middle parallel, the inconvenience will not be great though the meridians ſhould be ſtraight lines parallel to each other. Here he is ſaid only to mean, that the maps ſhould in ſome meaſure repreſent the figures of the countries for which they are drawn. In this ſenſe Mercator, who drew maps for Ptolemy's tables, underſtood him; thinking it, however, an improvement not to regulate the meridians by one parallel, but by two; one diſtant from the northern, the other from the ſouthern extremity of the map by a fourth part of the whole depth; by which means, in his maps, though the meridians are ſtraight lines, yet they are generally drawn inclining to each other towards the poles. With regard to Cortes, he ſpeaks only of the number of degrees of latitude, and not of the extent of them; nay, he gives expreſs directions that they ſhould all be laid down by equal meaſurement on a ſcale of leagues adapted to the map.

For ſome time after the appearance of Mercator's map, it was not rightly underſtood, and it was even thought to be entirely uſeleſs, if not detrimental.—However, about the year 1592, its utility began to be perceived; and ſeven years after, Mr Wright printed his famous treatiſe entitled, *The Correction of certain Errors in Navigation*, where he fully explained the reaſon of extending the length of the parallels of latitude, and the uſes of it to navigators. In 1610, a ſecond edition of Mr Wright's book was publiſhed with improvements. An excellent method was propoſed of determining the magnitude of the earth; at the ſame time it was judiciouſly propoſed to make our common meaſures in ſome proportion to a degree on its ſurface, that they might not depend on the uncertain length of a barley-corn. Some of his other improvements were, "The table of latitudes for dividing the meridian computed to minutes;" whereas it had only been divided to every tenth minute. He alſo publiſhed a deſcription of an inſtrument which he calls the *ſea-rings*; and by which the variation of the compaſs, altitude of the ſun, and time of the day, may be determined readily at once in any place, provided the latitude is known. He ſhowed alſo how to correct the errors ariſing from the eccentricity of the eye in obſerving by the croſs-ſtaff. He made a total amendment in the tables of the declinations and places of the ſun and ſtars from his own obſervations made with a ſix-foot quadrant in the years 1594, 95, 96, and 97. A ſea-quadrant to take altitudes by a forward or backward obſervation; and likewiſe with a contrivance for the ready finding the latitude by the height of the pole-ſtar, when not upon the meridian. To this edition was ſubjoined a tranſlation of Zamorano's Compendium above mentioned, in which he corrected ſome miſtakes in the original; adding a large table of the variation of the compaſs obſerved in very different parts of the world, to ſhow that it was not occaſioned by any magnetical pole.

Theſe improvements ſoon became known abroad.—In 1608, a treatiſe intitled, *Hypomnemata Mathematica*, was publiſhed by Simon Stevin, for the uſe of Prince Maurice. In that part relating to navigation, the author having treated of ſailing on a great circle, and ſhown how to draw the rhumbs on a globe mechanically, ſets down Wright's two tables of latitudes and of rhumbs, in order to deſcribe theſe lines more accurately, pretending even to have diſcovered an error in Wright's table. But all Stevin's objections were fully anſwered by the author himſelf, who ſhowed that they aroſe from the groſs way of calculating made uſe of by the former.

In 1624, the learned Wellebrordus Snellius, profeſſor of mathematics at Leyden, publiſhed a treatiſe of navigation on Wright's plan, but ſomewhat obſcurely; and as he did not particularly mention all the diſcoveries of Wright, the latter was thought by ſome to have taken the hint of all his diſcoveries from Snellius. But this ſuppoſition is long ago refuted; and Wright enjoys the honour of thoſe diſcoveries which is juſtly his due.

Mr Wright having ſhown how to find the place of the ſhip on his chart, obſerved that the ſame might be performed more accurately by calculation: but conſidering, as he ſays, that the latitudes, and eſpecially the courſes at ſea, could not be determined ſo preciſely, he forbore ſetting down particular examples; as the mariner may be allowed to ſave himſelf this trouble, and only mark out upon his chart the ſhip's way, after the manner then uſually practiſed. However, in 1614, Mr Raphe Handſon, among his nautical queſtions ſubjoined to a tranſlation of Pitiſcus's trigonometry, ſolved very diſtinctly every caſe of navigation, by applying arithmetical calculations to Wright's table of latitudes, or of meridional parts, as it hath ſince been called. Though the method diſcovered by Wright for finding the change of longitude by a ſhip ſailing on a rhumb is the proper way of performing it, Handſon alſo propoſes two ways of approximation to it without the aſſiſtance of Wright's diviſion of the meridian line. The firſt was computed by the arithmetical mean between the confines of both latitudes; the other by the ſame mean between the ſecants as an alternative, when Wright's book was not at hand; though this latter is wider from the truth than the firſt. By the ſame calculations alſo he ſhowed how much each of theſe compendiums deviates from the truth, and alſo how widely the computations on the erroneous principles of the plane chart differ from them all. The method, however, commonly uſed by our ſailors is commonly called the *middle latitude*; which, though it errs more than that by the arithmetical mean between the two co-ſines, is preferred on account of its being leſs operoſe: yet in high latitudes it is more eligible to uſe that of the arithmetical mean between the logarithmic co-ſines, equivalent to the geometrical mean between the co-ſines themſelves; a method ſince propoſed by Mr John Baſſat. The computation by the middle latitude will always fall ſhort of the true change of longitude; that by the geometrical mean will al-

ways

ways exceed; but that by the arithmetical mean falls ſhort in latitudes above 45 degrees, and exceeds in leſſer latitudes. However, none of theſe methods will differ much from the truth when the change of latitude is ſufficiently ſmall.

About this time logarithms were invented by John Napier, baron of Merchiſton in Scotland, and proved of the utmoſt ſervice to the art of navigation. From which Mr Edmund Gunter conſtructed a table of logarithmic ſines and tangents to every minute of the quadrant, which he publiſhed in 1620. In this work he applied to navigation, and other branches of mathematics, his admirable ruler known by the name of Gunter's ſcale *; on which are deſcribed lines of logarithms, of logarithmic ſines and tangents, of meridional parts, &c. He greatly improved the ſector for the ſame purpoſes. He ſhowed alſo how to take a back-obſervation by the croſs-ſtaff, whereby the error ariſing from the eccentricity of the eye is avoided. He deſcribed likewiſe another inſtrument, of his own invention, called the *croſs-bow*, for taking altitudes of the ſun or ſtars, with ſome contrivances for the more ready collecting the latitude from the obſervation. The diſcoveries concerning logarithms were carried to France in 1624 by Mr Edmund Wingate, who publiſhed two ſmall tracts in that year at Paris. In one of theſe he taught the uſe of Gunter's ſcale; and in the other, of the tables of artificial ſines and tangents, as modelled according to Napier's laſt form, erroneouſly attributed by Wingate to Briggs.

* See *Gunter's Scale.*

Gunter's rule was projected into a circular arch by the Reverend Mr William Oughtred in 1633, and its uſes fully ſhown in a pamphlet intitled, *The Circles of Proportion*, where, in an appendix, are well treated ſeveral important points in navigation. It has alſo been made in the form of a ſliding ruler.

The logarithmic tables were firſt applied to the different caſes of ſailing by Mr Thomas Addiſon, in his treatiſe intitled, *Arithmetical navigation*, printed in 1625. He alſo gives two traverſe tables, with their uſes; the one to quarter points of the compaſs, the other to degrees. Mr Henry Gellibrand publiſhed his diſcovery of the changes of the variation of the compaſs, in a ſmall quarto pamphlet, intitled, *A diſcourſe mathematical on the variation of the magnetical needle*, printed in 1635. This extraordinary phenomenon he found out by comparing the obſervations made at different times near the ſame place by Mr Burrough, Mr Gunter, and himſelf, all perſons of great ſkill and experience in theſe matters. This diſcovery was likewiſe ſoon known abroad; for Father Athanaſius Kircher, in his treatiſe intitled, *Magnes*, firſt printed at Rome in 1641, informs us, that he had been told it by Mr John Greaves; and then gives a letter of the famous Marinus Merſennus, containing a very diſtinct account of the ſame.

As altitudes of the ſun are taken on ſhipboard by obſerving his elevation above the viſible horizon, to obtain from thence the ſun's true altitude with correctneſs, Wright obſerves it to be neceſſary that the dip of the viſible horizon below the horizontal plane paſſing through the obſerver's eye ſhould be brought into the account, which cannot be calculated without knowing the magnitude of the earth. Hence he was induced to propoſe different methods for finding this; but complains that the moſt effectual was out of his power to execute; and therefore contented himſelf with a rude attempt, in ſome meaſure ſufficient for his purpoſe: and the dimenſions of the earth deduced by him correſponded very well with the uſual diviſions of the log-line; however, as he wrote not an expreſs treatiſe on navigation, but only for the correcting ſuch errors as prevailed in general practice, the log-line did not fall under his notice. Mr Richard Norwood, however, put in execution the method recommended by Mr Wright as the moſt perfect for meaſuring the dimenſions of the earth, with the true length of the degrees of a great circle upon it; and, in 1635, he actually meaſured the diſtance between London and York; from whence, and the ſummer ſolſtitial altitudes of the ſun obſerved on the meridian at both places, he found a degree on a great circle of the earth to contain 367,196 Engliſh feet, equal to 57,300 French fathoms or tortoiſes: which is very exact, as appears from many meaſures that have been made ſince that time. Of all this Mr Norwood gave a full account in his treatiſe called *The Seaman's Practice*, publiſhed in 1637. He there ſhows the reaſon why Snellius had failed in his attempt: he points out alſo various uſes of his diſcovery, particularly for correcting the groſs errors hitherto committed in the diviſions of the log-line. But neceſſary amendments have been little attended to by ſailors, whoſe obſtinacy in adhering to eſtabliſhed errors has been complained of by the beſt writers on navigation. This improvement has at length, however, made its way into practice, and few navigators of reputation now make uſe of the old meaſure of 42 feet to a knot. In that treatiſe alſo Mr Norwood deſcribes his own excellent method of ſetting down and perfecting a ſea-reckoning, by uſing a traverſe table; which method he had followed and taught for many years. He ſhows alſo how to rectify the courſe by the variation of the compaſs being conſidered; as alſo how to diſcover currents, and to make proper allowance on their account. This treatiſe, and another on trigonometry, were continually reprinted, as the principal books for learning ſcientifically the art of navigation. What he had delivered, eſpecially in the latter of them, concerning this ſubject, was contracted as a manual for ſailors, in a very ſmall piece called his *Epitome;* which uſeful performance has gone through a great number of editions. No alterations were ever made in the Seaman's Practice till the 12th edition in 1676, when the following paragraph was inſerted in a ſmaller character: "About the year 1672, Monſieur Picart has publiſhed an account in French, concerning the meaſure of the earth, a breviate whereof may be ſeen in the Philoſophical Tranſactions, N° 112. wherein he concludes one degree to contain 365,184 Engliſh feet, nearly agreeing with Mr Norwood's experiment;" and this advertiſement is continued through the ſubſequent editions as late as the year 1732.

About the year 1645, Mr Bond publiſhed in Norwood's epitome a very great improvement in Wright's method by a property in his meridian line, whereby its diviſions are more ſcientifically aſſigned than the author himſelf was able to effect; which was from this theorem, that theſe diviſions are analogous to the exceſſes of the logarithmic tangents of half the reſpective latitudes augmented by 45 degrees above the logarithm of the radius.

dius. This he afterwards explained more fully in the third edition of Gunter's works, printed in 1653; where, after obſerving that the logarithmic tangents from 45° upwards increaſe in the ſame manner that the ſecants added together do, if every half degree be accounted as a whole degree of Mercator's meridional line. His rule for computing the meridional parts belonging to any two latitudes, ſuppoſed on the ſame ſide of the equator, is to the following effect: "Take the logarithmic tangent, rejecting the radius, of half each latitude, augmented by 45 degrees; divide the difference of thoſe numbers by the logarithmic tangent of 45° 30′, the radius being likewiſe rejected; and the quotient will be the meridional parts required, expreſſed in degrees." This rule is the immediate conſequence from the general theorem, That the degrees of latitude bear to one degree (or 60 minutes, which in Wright's table ſtands for the meridional parts of one degree), the ſame proportion as the logarithmic tangent of half any latitude augmented by 45 degrees, and the radius neglected, to the like tangent of half a degree augmented by 45 degrees, with the radius likewiſe rejected. But here was farther wanting the demonſtration of this general theorem, which was at length ſupplied by Mr James Gregory of Aberdeen in his *Exercitationes Geometricæ*, printed at London in 1668; and afterwards more conciſely demonſtrated, together with a ſcientific determination of the diviſor, by Dr Halley in the Philoſophical Tranſactions for 1695, N° 219. from the conſideration of the ſpirals into which the rhumbs are transformed in the ſtereographic projection of the ſphere upon the plane of the equinoctial; and which is rendered ſtill more ſimple by Mr Roger Cotes, in his Logometria, firſt publiſhed in the Philoſophical Tranſactions for 1714, N° 388. It is moreover added in Gunter's book, that if $\frac{1}{10}$th of this diviſion, which does not ſenſibly differ from the logarithmic tangent of 45° 1′ 30″ (with the radius ſubtracted from it), be uſed, the quotient will exhibit the meridional parts expreſſed in leagues: and this is the diviſor ſet down in Norwood's Epitome. After the ſame manner the meridional parts will be found in minutes, if the like logarithmic tangent of 45° 1′ 30″, diminiſhed by the radius, be taken; that is, the number uſed by others being 12633, when the logarithmic tables conſiſt of eight places of figures beſides the index.

In an edition of the Seaman's Kalendar, Mr Bond declared, that he had diſcovered the longitude by having found out the true theory of the magnetic variation; and to gain credit to his aſſertion, he foretold, that at London in 1657 there would be no variation of the compaſs, and from that time it would gradually increaſe the other way; which happened accordingly. Again, in the Philoſophical Tranſactions for 1668, N° 40. he publiſhed a table of the variation for 49 years to come. Thus he acquired ſuch reputation, that his treatiſe, intitled, *The Longitude Found*, was in 1676 publiſhed by the ſpecial command of Charles II. and approved by many celebrated mathematicians. It was not long, however, before it met with oppoſition; and in 1678 another treatiſe, intitled, *The Longitude not Found*, made its appearance; and as Mr Bond's hypotheſis did not in any manner anſwer its author's ſanguine expectations, the affair was undertaken by Dr Halley. The reſult of his ſpeculation was, that the magnetic needle is influenced by four poles; but this wonderful phenomenon ſeems hitherto to have eluded all our reſearches. In 1700, however, Dr Halley publiſhed a general map, with curve lines expreſſing the paths where the magnetic needle had the ſame variation; which was received with univerſal applauſe. But as the poſitions of theſe curves vary from time to time, they ſhould frequently be corrected by ſkilful perſons; as was done in 1744 and 1756, by Mr William Mountaine, and Mr James Dodſon, F. R. S. In the Philoſophical Tranſactions for 1690, Dr Halley alſo gave a diſſertation on the monſoons; containing many very uſeful obſervations for ſuch as ſail to places ſubject to theſe winds.

After the true principles of the art were ſettled by Wright, Bond, and Norwood, the authors on navigation became ſo numerous, that it would be impoſſible to enumerate them. New improvements were daily made, and every thing relative to it was ſettled with an accuracy not only unknown to former ages, but which would have been reckoned utterly impoſſible. The earth being found to be a ſpheroid, and not a perfect ſphere, with the ſhorteſt diameter paſſing thro' the poles, a tract was publiſhed in 1741 by the Rev. Doctor Patrick Murdoch, wherein he accommodated Wright's ſailing to ſuch a figure; and Mr Colin Maclaurin, the ſame year, in the Philoſophical Tranſactions, N° 461. gave a rule for determining the meridional parts of a ſpheroid; which ſpeculation is farther treated of in his book of Fluxions, printed at Edinburgh in 1742.

Among the later diſcoveries in navigation, that of finding the longitude both by lunar obſervations and by time-keepers is the principal. It is owing chiefly to the rewards offered by the Britiſh parliament that this has attained the preſent degree of perfection. We are indebted to Dr Maſkelyne for putting the firſt of theſe methods in practice, and for other important improvements in navigation. The time-keepers, conſtructed by Harriſon for this expreſs purpoſe, were found to anſwer ſo well, that he obtained the parliamentary reward.

THEORY OF NAVIGATION.

THE motion of a ſhip in the water is well known to depend on the action of the wind upon its ſails, regulated by the direction of the helm. As the water is a reſiſting medium, and the bulk of the ſhip very conſiderable, it thence follows, that there is always a great reſiſtance on her fore-part; and when this reſiſtance becomes ſufficient to balance the moving force of the wind upon the ſails, the ſhip attains her utmoſt degree of velocity, and her motion is no longer accelerated. This velocity is different according to the different ſtrength of the wind; but the ſtronger the wind, the greater reſiſtance is made to the ſhip's paſſage through the water: and hence, though the wind ſhould blow ever ſo ſtrong, there is alſo a limit

to the velocity of the ſhip: for the ſails and ropes can bear but a certain force of air; and when the reſiſtance on the fore-part becomes more than equivalent to their ſtrength, the velocity can be no longer increaſed, and the rigging gives way.

The direction of a ſhip's motion depends on the poſition of her ſails with regard to the wind, combined with the action of the rudder. The moſt natural direction of the ſhip is, when ſhe runs directly before the wind, the ſails are then diſpoſed, ſo as to be at right angles thereto. But this is not always the caſe, both on account of the variable nature of the winds, and the ſituation of the intended port, or of intermediate headlands or iſlands. When the wind therefore happens not to be favourable, the ſails are placed ſo as to make an oblique angle both with the direction of the ſhip and with the wind; and the ſails, together with the rudder, muſt be managed in ſuch a manner, that the direction of the ſhip may make an acute angle with that of the wind; and the ſhip making boards on different tacks, will by this means arrive at the intended port.

The reaſon of the ſhip's motion in this caſe is, that the water reſiſts the ſide more than the fore-part, and that in the ſame proportion as her length exceeds her breadth. This proportion is ſo conſiderable, that the ſhip continually flies off where the reſiſtance is leaſt, and that ſometimes with great ſwiftneſs. In this way of ſailing, however, there is a great limitation: for if the angle made by the keel with the direction of the wind be too acute, the ſhip cannot be kept in that poſition; neither is it poſſible for a large ſhip to make a more acute angle with the wind than about 6 points; though ſmall ſloops, it is ſaid, may make an angle of about 5 points with it. In all theſe caſes, however, the velocity of the ſhip is greatly retarded; and that not only on account of the obliquity of her motion, but by reaſon of what is called her *lee-way*. This is occaſioned by the yielding of the water on the lee-ſide of the ſhip, by which means the veſſel acquires a compound motion, partly in the direction of the wind, and partly in that which is neceſſary for attaining the deſired port.

It is perhaps impoſſible to lay down any mathematical principles on which the lee-way of a ſhip could be properly calculated; only we may ſee in general that it depends on the ſtrength of the wind, the roughneſs of the ſea, and the velocity of the ſhip. When the wind is not very ſtrong, the reſiſtance of the water on the lee-ſide bears a very great proportion to that of the current of air: and therefore it will yield but very little: however, ſuppoſing the ſhip to remain in the ſame place, it is evident, that the water having once begun to yield, will continue to do ſo for ſome time, even though no additional force was applied to it; but as the wind continually applies the ſame force as at firſt, the lee-way of the ſhip muſt go on conſtantly increaſing till the reſiſtance of the water on the lee-ſide balances the force applied on the other, when it will become uniform, as doth the motion of a ſhip ſailing before the wind. If the ſhip changes her place with any degree of velocity, then every time ſhe moves her own length, a new quantity of water is to be put in motion, which hath not yet received any momentum, and which of conſequence will make a greater reſiſtance than it can do when the ſhip remains in the ſame place. In proportion to the ſwiftneſs of the ſhip, then the lee-way will be the leſs: but if the wind is very ſtrong, the velocity of the ſhip bears but a ſmall proportion to that of the current of air; and the ſame effects muſt follow as though the ſhip moved ſlowly, and the wind was gentle; that is, the ſhip muſt make a great deal of lee-way.—The ſame thing happens when the ſea riſes high, whether the wind is ſtrong or not; for then the whole water of the ocean, as far as the ſwell reaches, hath acquired a motion in a certain direction, and that to a very conſiderable depth. The mountainous waves will not fail to carry the ſhip very much out of her courſe; and this deviation will certainly be according to their velocity and magnitude. In all caſes of a rough ſea, therefore, a great deal of lee-way is made.—Another circumſtance alſo makes a variation in the quantity of the lee-way; namely, the lightneſs or heavineſs of the ſhip; it being evident, that when the ſhip ſinks deep in the water, a much greater quantity of that element is to be put in motion before ſhe can make any lee-way, than when ſhe ſwims on the ſurface. As therefore it is impoſſible to calculate all theſe things with mathematical exactneſs, it is plain that the real courſe of a ſhip is exceedingly difficult to be found, and frequent errors muſt be made, which only can be corrected by celeſtial obſervations.

In many places of the ocean there are *currents*, or places where the water, inſtead of remaining at reſt, runs with a very conſiderable velocity for a great way in ſome particular direction, and which will certainly carry the ſhip greatly out of her courſe. This occaſions an error of the ſame nature with the lee-way; and therefore, whenever a current is perceived, its velocity ought to be determined, and the proper allowances made.

Another ſource of error in reckoning the courſe of a ſhip proceeds from the variation of the compaſs. There are few parts of the world where the needle points exactly north; and in thoſe where the variation is known, it is ſubject to very conſiderable alterations. By theſe means the courſe of the ſhip is miſtaken; for as the ſailors have no other ſtandard to direct them than the compaſs, if the needle, inſtead of pointing due north, ſhould point north-eaſt, a prodigious error would be occaſioned during the courſe of the voyage, and the ſhip would not come near the port to which ſhe was bound. To avoid errors of this kind the only method is, to obſerve the ſun's amplitude and azimuth as frequently as poſſible, by which the variation of the compaſs will be perceived, and the proper allowances can then be made for errors in the courſe which this may have occaſioned.

Errors will ariſe in the reckoning of a ſhip, eſpecially when ſhe ſails in high latitudes, from the ſpheroidal figure of the earth; for as the polar diameter of our globe is found to be conſiderably ſhorter than the equatorial one, it thence follows, that the farther we remove from the equator, the longer are the degrees of latitude. Of conſequence, if a navigator aſſigns any certain number of miles for the length of a degree of latitude near the equator, he muſt vary that meaſure as he approaches towards the poles, otherwiſe he will imagine that he hath not ſailed ſo far as he actually hath done. It would therefore be neceſſary

to have a table containing the length of a degree of latitude in every different parallel from the equator to either pole; as without this a troubleſome calculation muſt be made at every time the navigator makes a reckoning of his courſe. Such a table, however, hath not yet appeared; neither indeed does it ſeem to be an eaſy matter to make it, on account of the difficulty of meaſuring the length even of one or two degrees of latitude in different parts of the world. Sir Iſaac Newton firſt diſcovered this ſpheroidal figure of the earth; and ſhowed, from experiments on pendulums, that the polar diameter was to the equatorial one as 229 to 230. This proportion, however, hath not been admitted by ſucceeding calculators. The French mathematicians, who meaſured a degree on the meridian in Lapland, made the proportion between the equatorial and polar diameters to be as 1 to 0.9891. Thoſe who meaſured a degree at Quito in Peru, made the proportion 1 to 0.99624, or 266 to 265. M. Bouquer makes the proportion to be as 179 to 178; and M. Buffon, in one part of his theory of the earth, makes the equatorial diameter exceed the polar one by $\frac{1}{107}$ of the whole. According to M. du Sejour, this proportion is as 321 to 320; and M. de la Place, in his Memoir upon the Figure of Spheroids, has deduced the ſame proportion. From theſe variations it appears that the point is not exactly determined, and conſequently that any corrections which can be made with regard to the ſpheroidal figure of the earth muſt be very uncertain.

It is of conſequence to navigators in a long voyage to take the neareſt way to their port; but this can ſeldom be done without conſiderable difficulty. The ſhorteſt diſtance between any two points on the ſurface of a ſphere is meaſured by an arch of a great circle intercepted between them; and therefore it is adviſable to direct the ſhip along a great circle of the earth's ſurface. But this is a matter of conſiderable difficulty, becauſe there are no fixed marks by which it can be readily known whether the ſhip ſails in the direction of a great circle or not. For this reaſon the ſailors commonly chooſe to direct their courſe by the rhumbs, or the bearing of the place by the compaſs. Theſe bearings do not point out the ſhorteſt diſtance between places; becauſe, on a globe, the rhumbs are ſpirals, and not arches of great circles. However, when the places lie directly under the equator, or exactly under the ſame meridian, the rhumb then coincides with the arch of a great circle, and of conſequence ſhows the neareſt way. The ſailing on the arch of a great circle is called *great circle ſailing*; and the caſes of it depend all on the ſolution of problems in ſpherical trigonometry.

PRACTICE OF NAVIGATION.

BOOK I.

Containing the various Methods of Sailing.

Introduction.

The art of navigation depends upon aſtronomical and mathematical principles. The places of the ſun and fixed ſtars are deduced from obſervation and calculation, and arranged in tables, the uſe of which is abſolutely neceſſary in reducing obſervations taken at ſea, for the purpoſe of aſcertaining the latitude and longitude of the ſhip, and the variation of the compaſs. The problems in the various ſailings are reſolved either by trigonometrical calculation, or by tables or rules formed by the aſſiſtance of trigonometry. By mathematics, the neceſſary tables are conſtructed, and rules inveſtigated for performing the more difficult parts of navigation. For theſe ſeveral branches of ſcience, and for logarithmic tables, the reader is referred to the reſpective articles in this work. A few tables are given at the end of this article; but as the other tables neceſſary for the practice of navigation are to be found in almoſt every treatiſe on that ſubject, it therefore ſeems unneceſſary to inſert them in this place.

Chap. I. *Preliminary Principles.*

Sect. I. *Of the Latitude and Longitude of a Place.*

The ſituation of a place on the ſurface of the earth is eſtimated by its diſtance from two imaginary lines interſecting each other at right angles: The one of theſe is called the *equator*, and the other the *firſt meridian*. The ſituation of the equator is fixed, but that of the firſt meridian is arbitrary, and therefore different nations aſſume different firſt meridians. In Britain, we eſteem that to be the firſt meridian which paſſes through the royal obſervatory at Greenwich.

The equator divides the earth into two equal parts, called the *northern* and *ſouthern hemiſpheres*; and the latitude of a place is its diſtance from the equator, reckoned on a meridian in degrees and parts of a degree; and is either north or ſouth, according as it is in the northern or ſouthern hemiſphere.

The firſt meridian being continued round the globe, divides it into two equal parts, called the *eaſtern* and *weſtern hemiſpheres*; and the longitude of a place is that portion of the equator contained between the firſt meridian and the meridian of the given place, and is either eaſt or weſt; according as it is in the eaſtern or weſtern hemiſphere, reſpectively to the firſt meridian.

Prob. I. The latitudes of two places being given, to find the difference of latitude.

Rule. Subtract the leſs latitude from the greater, if the latitudes be of the ſame name, but add them if of contrary; and the remainder or ſum will be the difference of latitude.

Example I. Required the difference of latitude between the Lizard, in latitude 49° 57′ N. and Cape St Vincent, in latitude 37° 2′ N?

Latitude of the Lizard	49°	57′ N.
Latitude of Cape St Vincent	37	2 N.
Difference of latitude	12	55 = 775 miles.

Example II. What is the difference of latitude between Funchal, in latitude 32° 38′ N. and the Cape of Good Hope, in latitude 34° 29′ S?

Latitude and Longitude.

Latitude of Funchal	32° 38′ N.	
Lat. of Cape of Good Hope	34 29 S.	
Difference of latitude	67 7	= 4027 miles.

Prob. II. Given the latitude of one place, and the difference of latitude between it and another place, to find the latitude of that place.

Rule. If the given latitude and the difference of latitude be of the same name, add them; but if of different names, subtract them, and the sum or remainder will be the latitude required of the same name with the greater.

Example I. A ship from latitude 39° 22′ N. sailed due north 560 miles—Required the latitude come to?

Latitude sailed from -	39° 22′ N.	
Difference of latitude 560′ -	= 9 20 N.	
Latitude come to - -	48 42 N.	

Example II. A ship from latitude 7° 19′ N. sailed 854 miles south—Required the latitude come to?

Latitude sailed from - -	7° 19′ N.	
Difference of latitude 854′ -	= 14 14 S.	
Latitude come to - -	6 55 S.	

Prob. III. The longitudes of two places being given, to find their difference of longitude.

Rule. If the longitudes of the given places are of the same name, subtract the less from the greater, and the remainder is the difference of longitude: but if the longitudes are of contrary names, their sum is the difference of longitude. If this exceeds 180°, subtract it from 360°, and the remainder is the difference of longitude.

Example I. Required the difference of longitude between Edinburgh and New York, their longitude being 3° 14′ W. and 74° 10′ W. respectively?

Longitude of New York - -	74° 10′ W.	
Longitude of Edinburgh - -	3 14 W.	
Difference of longitude - -	70 56	

Example II. What is the difference of longitude between Markelyne's Isles, in longitude 167° 59′ E. and Olinde, in longitude 35° 5′ W?

Longitude of Markelyne's Isles	167° 59′ E.	
Longitude of Olinde -	35 5 W.	
Sum - - - -	203 4	
Subtract from - -	360 0	
Difference of longitude -	156 56	

Prob. IV. Given the longitude of a place, and the difference of longitude between it and another place, to find the longitude of that place.

Rule. If the given longitude and the difference of longitude be of a contrary name, subtract the less from the greater, and the remainder is the longitude required of the same name with the greater quantity; but if they are of different names, add them, and the sum is the longitude sought, of the same name with that given. If this sum exceeds 180°, subtract it from 360°, the remainder is the required longitude of a contrary name to that given.

Example I. A ship from longitude 9° 54′ E. sailed westerly till the difference of longitude was 23° 18′—Required the longitude come to?

Longitude sailed from - -	9° 54′ E.	
Difference of longitude - -	23 18 W.	
Longitude come to - -	13 24 W.	

Example II. The longitude sailed from is 25° 9′ W. and difference of longitude 18° 46′ W.—Required the longitude come to?

Longitude left - -	25° 9′ W.	
Difference of longitude - -	18 46 W.	
Longitude in - -	43 55 W.	

Tides.

Sect. II. *Of the Tides.*

The theory of the tides has been explained under the article Astronomy, and will again be farther illustrated under that of Tides. In this place, therefore, it remains only to explain the method of calculating the time of high water at a given place.

As the tides depend upon the joint actions of the sun and moon, and therefore upon the distance of these objects from the earth and from each other; and as, in the method generally employed to find the time of high water, whether by the mean time of new moon or by the epacts, or tables deduced therefrom, the moon is supposed to be the sole agent, and to have an uniform motion in the periphery of a circle, whose centre is that of the earth; it is hence obvious that method cannot be accurate, and by observation the error is sometimes found to exceed two hours. That method is therefore rejected, and another given, in which the error will seldom exceed a few minutes, unless the tides are greatly influenced by the winds.

Prob. I. To reduce the times of the moon's phases as given in the Nautical Almanac to the meridian of a known place.

Rule. To the time of the proposed phase, as given in the Nautical Almanac, apply the longitude of the place in time, by addition or subtraction, according as it is east or west, and it will give the time of the phase at the given place.

Example I. Required the time of new moon at Salonique in May 1793?

Time of new moon per Naut. Alm.	9d	15h	31′
Longitude of Salonique in time	0	1	33 E.
Time of new moon required in May	9	17	4

Example II. What is the time of the last quarter of the moon at Resolution Bay in October 1793?

Time of last quarter per Naut. Alm.	26d	5h	47′
Longitude in time - -	0	9	17 W.
Time at Resolution bay of last quarter, October - -	25	20	30

Prob. II. To find the time of high water at a known place.

Rule. In the Nautical Almanac seek in the given month, or in that immediately preceding or following it, for the time of that phase which happens nearest to the given day; reduce the time of this phase to the meridian of the given place by Prob. I. and take the difference between the reduced time and the noon of the given day.

Find the equation answering to this difference in Table VII. which applied to the time of high wa-

Tides. ter on the day of new or full moon at the given place, according as the table directs, will give the approximate time of high water in the afternoon.

Now take the interval between the reduced time of the phaſe and the approximate time of high water; find the correſponding equation, which applied as before to the ſyzigy time of high water, will give the time of the afternoon high water.

If the time of the morning high water is required, increaſe the laſt interval by 12 hours, if the given day falls before the phaſe, or diminiſh it by 12 hours when after that phaſe; and the equation to this time, applied to the ſyzigy time, gives the morning time of high water.

EXAMPLE I. Required the morning and afternoon times of high water at Leith, 11th December 1793?

Neareſt phaſe to 11th Dec. is 1ſt quart.	9d	20h	29′
Longitude of Leith in time —	0	0	13
Time at Leith of 1ſt quarter	9	20	16
Given day - -	11	0	0
Difference - -	1	3	44
Time of H W. at Leith-pier on ſyz.	0	2	20
Equat. from Tab. to 1d 3h 44′ +	0	6	32
Approximate time of high water	11	8	52
Reduced time of 1ſt quarter -	9	20	16
Interval - - -	1	12	36
Time of high water at Leith on ſyz.	0	2	20
Equat. from the Tab. to 1d 12h 36′	0	7	0
Time of high water at Leith		9	20 P.M.
Time of H. W. at Leith at full & change		2	20
Equat. to 1d 12h 36′ — 12h = 1d 0h 36′		6	22
High water at Leith, Dec. 11th, at		8	42 A.M.

The time of high water found by the common method is about an hour and a half ſooner.

EXAMPLE II. Required the time of high water at Funchal, 15th November 1793?

The neareſt phaſe to 15th November is that of full moon, - - -	17d	8h	46′
Longitude of Funchal in time, -	0	1	8 W.
Time of full moon at Funchal, -	17d	7	38
Given day, November -	15	0	0
Difference, - -	2	7	38
Time of high water at Funchal at full and change, - - -	0	12	4
Equation from the Table to 2d 7h 38′ before full moon, - —	0	1	35
Approx. time of high water, Nov. 15.	0	10	29
Reduced time of full moon, -	17	7	38
Interval, - -	1	11	9
Time of high water at full and change,	0	12	4
Equation to 1d 11h before full moon,	0	0	56
Time of high water, - -	0	11	8 PM.

Equation to 1 d. 11 h. + 12 h. = 1 d. 23 h. is 1 h. 15′, and 12 h. 4′ — 1 h. 15′ = 10 h. 49′ = time of high water in the forenoon. Ship's Run.

EXAMPLE III. Required the time of high water at Duſkey Bay, 24th October 1793?

The neareſt phaſe to the 24th October is the laſt quarter, - - -	26d	5h	47′
Longitude of Duſkey Bay in time, +	0	11	5 E.
Reduced time of firſt quarter of moon,	26	16	52
Given day, - -	24	0	0
Difference, - -	2	16	52
Time of high water at full and change,		10h	57′
Equation to 2d 16h 52′ before laſt quarter, -	+	2	52
Approximate time of high water,		1	49
Change of equation to app. time 1h 49′			3
Time of high water in the afternoon,		1	52
Change of equation to 12 hours, -			20
Time of high water in the morning,		1	32

SECT. III. *Of meaſuring a Ship's Run in a given Time.*

The method commonly uſed at ſea to find the diſtance ſailed in a given time, is by means of a log-line and half minute-glaſs. A deſcription of theſe is given under the articles LOG and LOG-LINE, which ſee.

It has been already obſerved, that the interval between each knot on the line ought to be 50 feet, in order to adapt it to a glaſs that runs 30 ſeconds. But although the line and glaſs be at any time perfectly adjuſted to each other, yet as the line ſhrinks after being wet, and as the weather has a conſiderable effect upon the glaſs, it will therefore be neceſſary to examine them from time to time; and the diſtance given by them muſt be corrected accordingly. The diſtance ſailed may therefore be affected by an error in the glaſs, or in the line, or in both. The true diſtance may, however, be found as follows.

PROB. I. The diſtance ſailed by the log, and the ſeconds run by the glaſs, being given, to find the true diſtance, the line being ſuppoſed right.

RULE.—Multiply the diſtance given by the log by 30, and divide the product by the ſeconds run by the glaſs, the quotient will be the true diſtance.

EXAMPLE I. The hourly rate of ſailing by the log is nine knots, and the glaſs is found to run out in 35 ſeconds. Required the true rate of ſailing?

9
30

35)270(7.7 = true rate of ſailing.

EXAMPLE II. The diſtance ſailed by the log is 73 miles, and the glaſs runs out in 26 ſeconds. Sought the true diſtance?

73
30

26(2190)84.2 the true diſtance.

PROB. II. Given the diſtance ſailed by the log, and the meaſured interval between two adjacent knots on

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the line, to find the true distance, the glass running exactly 30 seconds.

Rule. Multiply twice the distance sailed by the measured length of a knot, point off two figures to the right, and the remainder will be the true distance.

Example I. The hourly rate of sailing by the log is five knots, and the interval between knot and knot measures 53 feet. Required the true rate of sailing?

Measured interval	=	53
Twice hourly rate	=	10
True rate of sailing,	=	5.30

Example II. The distance sailed is 64 miles, by a log-line which measures 42 feet to a knot. Required the true distance?

Twice given distance,	=	128
Measured interval,		42
		256
		512
True distance,		53.76

Prob. III. Given the length of a knot, the number of seconds run by the glass in half a minute, and the distance sailed by the log; to find the true distance.

Rule. Multiply the distance sailed by the log by six times the measured length of a knot, and divide the product by the seconds run by the glass, the quotient, pointing off one figure to the right, will be the true distance.

Example. The distance sailed by the log is 159 miles, the measured length of a knot is 42 feet, and the glass runs 33 seconds in half a minute. Required the true distance?

Distance by the log,		159
Six times length of a knot=42×6=		252
		318
		795
		318
Second run by the glass = true distance.	=	33)40068(121.4=

Chap. II. *Of Plane Sailing,*

Plane sailing is the art of navigating a ship upon principles deduced from the notion of the earth's being an extended plane. On this supposition the meridians are esteemed as parallel right lines. The parallels of latitude are at right angles to the meridians; the lengths of the degrees on the meridians, equator, and parallels of latitude, are every where equal; and the degrees of longitude are reckoned on the parallels of latitude as well as on the equator.—In this sailing four things are principally concerned, namely, the *course*, *distance*, *difference of latitude*, and *departure*.

The course is the angle contained between the meridian and the line described by the ship, and is usually expressed in points of the compass.

The distance is the number of miles a ship has sailed on a direct course in a given time.

The difference of latitude is the portion of a meridian contained between the parallels of latitude sailed from and come to; and is reckoned either north or south, according as the course is in the northern or southern hemisphere.

Plane Sailing.

The departure is the distance of the ship from the meridian of the place she left, reckoned on a parallel of latitude. In this sailing, the departure and difference of longitude are esteemed equal.

In order to illustrate the above, let A (fig, 1.) represent the position of any given place, and AB the meridian passing through that place; also let AC represent the line described by a ship, and C the point arrived at. From C draw CB perpendicular to AB. Now in the triangle ABC, the angle BAC represents the course, the side AC the distance, AB the difference of latitude, and BC the departure. Plate CCCXXXVII.

In constructing a figure relating to a ship's course, let the upper part of what the figure is to be drawn on represent the *north*, then the lower part will be *south*, the right-hand side *east*, and the left-hand side *west*.

A north and south line is to be drawn to represent the meridian of the place from which the ship sailed; and the upper or lower part of this line, according as the course is southerly or northerly, is to be marked as the position of that place. From this point as a centre, with the chord of 60°, an arch is to be described from the meridian towards the right or left, according as the course is easterly or westerly; and the course, taken from the line of chords if given in degrees, but from the line of rhumbs if expressed in points of the compass, is to be laid upon this arch, beginning at the meridian. A line drawn through this point and that sailed from, will represent the distance, which if given must be laid thereon, beginning at the point sailed from. A line is to be drawn from the extremity of the distance perpendicular to the meridian; and hence the difference of latitude and departure will be obtained.

If the difference of latitude is given, it is to be laid upon the meridian, beginning at the point representing the place the ship left; and a line drawn from the extremity of the difference of latitude perpendicular to the meridian, till it meets the distance produced, will limit the figure.

If the departure is given, it is to be laid off on a parallel, and a line drawn through its extremity will limit the distance. When either the distance and difference of latitude, distance and departure, or difference of latitude and departure, are given, the measure of each is to be taken from a scale of equal parts, is to be laid off on its respective line, and the extremities connected. Hence the figure will be formed.

Prob. I. Given the course and distance, to find the difference of latitude and departure.

Example. A ship from St Helena, in latitude 15° 55′ N. sailed S. W. by S. 158 miles. Required the latitude come to, and departure?

By construction.

Draw the meridian AB (fig. 2.), and with the chord of 60° describe the arch *mn*, and make it equal to the rhumb of 3 points, and through *e* draw AC equal to 158 miles; from C draw CB perpendicular to AB; then AB applied to the scale from which AC was taken, will be found to measure 131.4 and BC 87.8.

By

Plane Sailing.

By Calculation.

To find the difference of latitude.

As radius - -		10.00000
is to the co-fine of the courſe	3 points	9.91985
ſo is the diſtance -	158	2.19866
to the difference of latitude	131.4	2.11851

To find the departure.

As radius - - -		10.00000
is to the ſine of the courſe	3 points	9 74474
ſo is the diſtance -	158	2.19866
to the departure -	87.8	1.94340

By Inſpection.

In the traverſe table, the difference of latitude anſwering to the courſe 3 points, and diſtance 158 miles, in a diſtance column is 131.4, and departure 87.8.

By Gunter's Scale.

The extent from 8 points to 5 points, the complement of the courſe on the line of ſine rhumbs (marked SR.) will reach from the diſtance 158 to 131.4, the difference of latitude on the line of numbers; and the extent from 8 points to 3 points on ſine rhumbs, will reach from 158 to 87.8, the departure on numbers.

Latitude St Helena	=	15° 55′ N.
Difference of latitude -		2 11 S.
Latitude come to -		13 44 N.

Prob. II. Given the courſe and difference of latitude, to find the diſtance and departure.

Example. A ſhip from St George's, in latitude 38° 45′ north, ſailed SE½S; and the latitude by obſervation was 35° 7′ N. Required the diſtance, run, and departure?

Latitude St George's -	38° 45′	N.
Latitude come to -	35 7	N.
Difference of latitude	3 38 = 218 miles.	

By Conſtruction.

Plate CCCXXXVII.

Draw the portion of the meridian AB (fig. 3.) equal to 218 m. from the centre A with the chord of 60° deſcribe the arch *m n*, which make equal to the rhumb of 3½ points: through A*e* draw the line AC, and from B draw BC perpendicular to AB, and let it be produced till it meets AC in C. Then the diſtance AC being applied to the ſcale will meaſure 282 m. and the departure BC 179 miles.

By Calculation.

To find the diſtance.

As radius - -		10.00000
is to the ſecant of the courſe	3½ points	10.11181
ſo is the difference of latitude	218 m.	2.33846
to the diſtance -	282	2.45027

To find the departure.

As radius - -		10.00000
is to the tangent of the courſe	3½ pts.	9.91417
ſo is the difference of latitude	218	2.33846
to the departure -	178.9	2.25253

By Inſpection.

Find the given difference of latitude 218 m. in a latitude column, under the courſe 3½ points; oppoſite to which, in a diſtance column, is 282 miles; and in a departure column is 178.9 m.

Plane Sailing.

By Gunter's Scale.

Extend the compaſs from 4½ points, the complement of the courſe to 8 points on ſine rhumbs, that extent will reach from the difference of latitude 218 miles to the diſtance 282 miles in numbers; and the extent from 4 points to the courſe 3½ points on the line of tangent rhumbs (marked T. R.) will reach from 218 miles to 178.9, the departure on numbers.

Prob. III. Given courſe and departure, to find the diſtance and difference of latitude?

Example. A ſhip from Palma, in latitude 28° 37′ N ſailed NW by W, and made 192 miles of departure: Required the diſtance, run, and latitude come to?

By Conſtruction.

Make the departure BC (fig. 4.) equal to 192 miles, draw BA perpendicular to BC, and from the centre C, with the chord of 60°, deſcribe the arch *m n*, which make equal to the rhumb of 3 points, the complement of the courſe; draw a line through C*e*, which produce till it meets BA in A: then the diſtance AC being meaſured, will be equal to 231 m. and the difference of latitude AB will be 128.3 miles.

By Calculation.

To find the diſtance.

As the ſine of the courſe	5 points	9.91985
is to radius -	-	10.00000
ſo is the departure -	192 -	2.28330
to the diſtance -	230.9	2.36345

To find the difference of latitude.

As the tangent of the courſe	5 points	10.17511
is to radius -	-	10.00000
ſo is the departure -	192	2.28330
to the difference of latitude	128.3	2.10819

By Inſpection.

Find the departure 192 m. in its proper column above the given courſe 5 points; and oppoſite thereto is the diſtance 231 miles, and difference of latitude 138.3, in their reſpective columns.

By Gunter's Scale.

The extent from 5 points to 8 points on the line of ſine rhumbs being laid from the departure 192 on numbers, will reach to the diſtance 231 on the ſame line; and the extent from 5 points to 4 points on the line of tangent rhumbs will reach from the departure 192 to the difference of latitude 128.3 on numbers.

Latitude of Palma -	28° 37′	N
Difference of latitude - -	2 8	N
Latitude come to - -	30 45	N

Prob. IV. Given the diſtance and difference of latitude, to find the courſe and departure.

Example. A ſhip from a place in latitude 43° 13′ N, ſails between the north and eaſt 285 miles; and is then by obſervation found to be in latitude 46° 31′ N: Required the courſe and departure?

Latitude ſailed from -	43° 13′	N
Latitude by obſervation	46 31	N
Difference of latitude -	3 18 = 198 miles.	

By Conſtruction.

Draw the portion of the meridian AB (fig. 5.) equal to 198 miles; from B draw BC perpendicular to

Plane Sailing.

to AB: then take the distance 285 miles from the scale, and with one foot of the compass in A describe an arch intersecting BC in C, and join AC. With the chord of 60° describe the arch *m n*, the portion of which, contained between the distance and difference of latitude, applied to the line of chords, will measure 46°, the course; and the departure BC being measured on the line of equal parts, will be found equal to 205 miles.

By Calculation.

To find the course.

As the distance - -	285	2.45484
is to the difference of latitude	198	2.29660
so is the radius - -		10.00000
to the cosine of the course	46° 0′	9.84176

To find the departure.

As radius - -		10.00000
is to the sine of the course	46° 0′	9.85693
so is the distance - - -	285	2.45484
to the departure -	205	2.31177

By Inspection.

Find the given distance in the table in its proper column; and if the difference of latitude answering thereto is the same as that given, namely 198, then the departure will be found in its proper column, and the course at the top or bottom of the page, according as the difference of latitude is found in a column marked *lat.* at top or bottom. If the difference of latitude thus found does not agree with that given, turn over till the nearest thereto is found to answer to the given distance. This is in the page marked 46 degrees at the bottom, which is the course, and the corresponding departure is 205 miles.

By Gunter's Scale.

The extent from the distance 285 to the difference of latitude 198 on numbers, will reach from 90° to 44°, the complement of the course on sines; and the extent from 90° to the course 46° on the line of sines being laid from the distance 285, will reach to the departure 205 on the line of numbers.

Prob. V. Given the distance and departure, to find the course and difference of latitude.

Example. A ship from Fort-Royal in the island of Grenada, in latitude 12° 9′ N, sailed 260 miles between the south and west, and made 190 miles of departure: Required the course and latitude come to?

By Construction.

Plate ccxxxvii.

Draw BC (fig 6.) perpendicular to AB, and equal to the given departure 190 miles; then from the centre C, with the distance 260 miles, sweep an arch intersecting AB in it, and join AC. Now describe an arch from the centre A with the chord of 60°, and the portion *m n* of this arch, contained between the distance and difference of latitude, measured on the line of chords, will be 47° the course; and the difference of latitude AB applied to the scale of equal parts, measures miles.

By Calculation.

To find the course.

As the distance -	260 -	2.41497
is to the departure	190 -	2.27875
so is radius - -		10.00000
to the sine of the course	46° 57′	9.86378

Plane Sailing.

To find the difference of latitude.

As radius - -		10.00000
is to the cosine of the course	46° 57′	9.83419
so is the distance -	260	2.41497
to the difference of latitude	177.5	2.24916

By Inspection.

Seek in the traverse table until the nearest to the given departure is found in the same line with the given distance 260. This is found to be in the page marked 47° at the bottom, which is the course; and the corresponding difference of latitude is 177.3.

By Gunter's Scale.

The extent of the compass, from the distance 260 to the departure 190 on the line of numbers, will reach from 90° to 47°, the course on the line of sines: and the extent from 90° to 43°, the complement of the course on sines, will reach from the distance 260 to the difference of latitude 177½ on the line of numbers.

Latitude Fort-Royal - -		12 9 N
Difference of latitude -	177 -	=2 57 S
Latitude in - -		9 12 N

Prob. VI. Given difference of latitude and departure, sought course and distance.

Example. A ship from a port in latitude 7° 56′ S, sailed between the south and east, till her departure is 132 miles; and is then by observation found to be in latitude 12° 3′ S. Required the course and distance?

Latitude sailed from -	7° 56′ S.
Latitude in by observation	12 3 S.
Difference of latitude -	4 7=247.

By Construction.

Draw the portion of the meridian AB (fig. 7.) equal to the difference of latitude 247 miles; from B draw BC perpendicular to AB, and equal to the given departure 132 miles, and join AC: then with the chord of 60° describe an arch from the centre A; and the portion *mn* of this arch being applied to the line of chords, will measure about ; and the distance AC, measured on the line of equal parts, will be 280 miles.

By Calculation.

To find the course.

As the difference of latitude -	247	2.39270
is to the departure - -	132	2.12057
so is radius - - -		10.00000
to the tangent of the course -	28° 7′	9.72787

To find the distance.

As radius - -		10.00000
is to the secant of the course	28° 7′	10.05454
so is the difference of latitude	247	2.39270
to the distance -	280	2.44724

By Inspection.

Seek in the table till the given difference of latitude and departure, or the nearest thereto, are found together in their respective columns, which will be under 28°, the required course; and the distance answering thereto is 280 miles.

By Gunter's Scale.

The extent from the given difference of latitude 247 to

Traverſe Sailing.

to the departure 132 on the line of numbers, will reach from 45° to 28°, the courſe on the line of tangents; and the extent from 62°, the complement of the courſe, to 90° on ſines, will reach from the difference of latitude 247 to the diſtance 280 on numbers.

CHAP. III. *Of Traverſe Sailing.*

IF a ſhip ſails upon two or more courſes in a given time, the irregular track ſhe deſcribes is called a *traverſe*; and to reſolve a traverſe is the method of reducing theſe ſeveral courſes, and the diſtances run, into a ſingle courſe and diſtance. The method chiefly uſed for this purpoſe at ſea is by inſpection, which ſhall therefore be principally adhered to; and is as follows.

Make a table of a breadth and depth ſufficient to contain the ſeveral courſes, &c. This table is to be divided into ſix columns: the ſeveral courſes are to be put in the firſt, and the correſponding diſtances in the ſecond column; the third and fourth columns are to contain the differences of latitude, and the two laſt the departures.

Now, the ſeveral courſes and their correſponding diſtances being properly arranged in the table, find the difference of latitude and departure anſwering to each in the traverſe table; remembering that the difference of latitude is to be put in a north or ſouth column, according as the courſe is in the northern or ſouthern hemiſphere; and that the departure is to be put in an eaſt column if the courſe is eaſterly, but in a weſt column if the courſe is weſterly: Obſerving alſo, that the departure is leſs than the difference of latitude when the courſe is leſs than 4 points or 45°; otherwiſe greater.

Add up the columns of northing, ſouthing, eaſting, and weſting, and ſet down the ſum of each at its bottom; then the difference between the ſums of the north and ſouth columns will be the difference of latitude made good, of the ſame name with the greater; and the difference between the ſums of the eaſt and weſt columns, is the departure made good, of the ſame name with the greater ſum.

Now ſeek in the traverſe table, till a difference of latitude and departure are found to agree as nearly as poſſible with thoſe above; then the diſtance will be found on the ſame line, and the courſe at the top or bottom of the page according as the difference of latitude is greater or leſs than the departure.

In order to reſolve a traverſe by conſtruction, deſcribe a circle with the chord of 60°, in which draw two diameters at right angles to each other, at whoſe extremities are to be marked the initials of the cardinal points, north being uppermoſt.

Lay off each courſe on the circumference, reckoned from its proper meridian; and from the centre to each point draw lines, which are to be marked with the proper number of the courſe.

On the firſt radius lay off the firſt diſtance from the centre; and through its extremity, and parallel to the ſecond radius, draw the ſecond diſtance of its proper length; through the extremity of the ſecond diſtance, and parallel to the third radius, draw the third diſtance of its proper length; and thus proceed until all the diſtances are drawn. Traverſe Sailing. Practice.

A line drawn from the extremity of the laſt diſtance to the centre of the circle will repreſent the diſtance made good: and a line drawn from the ſame point perpendicular to the meridian, produced, if neceſſary, will repreſent the departure; and the portion of the meridian intercepted between the centre and departure will be the difference of latitude made good.

EXAMPLES.

I. A ſhip from Fyal, in latitude 38° 32′ N, ſailed as follows: ESE 163 miles, SW ¼ W 110 miles, SE ¼ S 180 miles, and N by E 68 miles. Required the latitude come to, the courſe, and diſtance made good?

By Inſpection.

Courſe.	Diſt.	Diff. of Latitude. N	Diff. of Latitude. S	Departure. E	Departure. W
ESE	163	—	62.4	150.6	—
SW ¼ W	110	—	69.8	—	85.0
SE ¼ S	180	—	144.5	107.2	—
N *b* E	68	66.7	—	13.3	—
		66.7	276.7	271.1	
			66.7	85.0	
S 41 ½ E	281		210.0	186.1	

Latitude left,	-	38° 32′ N.
Difference of latitude,		3 21 S.
Latitude come to	-	35 11 N.

By Conſtruction.

With the chord of 60° deſcribe the circle NE,SW (fig. 8), the centre of which repreſents the place the ſhip ſailed from: draw two diameters NS, EW at right angles to each other; the one repreſenting the meridian, and the other the parallel of latitude of the place ſailed from. Take each courſe from the line of rhumbs, lay it off on the circumference from its proper meridian, and number it in order 1, 2, 3, 4. Upon the firſt rhumb C1, lay off the firſt diſtance from C to A; through it draw the ſecond diſtance AB parallel to C2, and equal to 110 miles; through B draw BD equal to 180 miles, and parallel to C3; and draw DE parallel to C4, and equal to 68 miles. Now CE being joined, will repreſent the diſtance made good; which applied to the ſcale will meaſure 281 miles. The arch S*n*, which repreſents the courſe, being meaſured on the line of chords, will be found equal to 41½°. From E draw EF perpendicular to CS produced; then CF will be the difference of latitude, and FE the departure made good; which applied to the ſcale will be found to meaſure 210 and 186 reſpectively. Plate CCCXXXVII.

As the method by conſtruction is ſcarcely ever practiſed at ſea, it therefore ſeems unneceſſary to apply it to the ſolution of the following examples.

Traverse Sailing.

II. A ship from latitude 1° 38′ S sailed as under. Required her present latitude, course, and distance made good?

Course.	Dist.	Diff. of Latitude. N	Diff. of Latitude. S	Departure. E	Departure. W
NW b N	43	35.8	—	—	23.9
WNW	78	29.9	—	—	72.1
SE b E	56	—	31.1	46.6	—
WSW ½ W	62	—	18.0	—	59.3
N ¾ E	85	84.1	—	12.5	—
		149.8	49.1	59.1	155.3
		49.1			59.1
N 44° W	139	100.7 = 1° 41′			96.2
Latitude left -		1 38 S.			
Latitude come to -		0 3 N.			

III. Yesterday at noon we were in latitude 13° 12′ N, and since then have run as follows: SSE 36 miles, S 12 miles, NW ½ W 28 miles, W 30 miles, SW 42 miles, W b N 39 miles, and N 20 miles. Required our present latitude, departure, and direct course and distance?

Courses.	Dist.	Diff. of Latitude. N	Diff. of Latitude. S	Departure. E	Departure. W
SSE	36	—	33.3	13.8	—
S	12	—	12.0	—	—
NW ½ W	28	17.8	—	—	21.6
W	30	—	—	—	30.0
SW	42	—	29.7	—	29.7
W b N	39	7.6	—	—	38.2
N	20	20.0	—	—	—
		45.4	75.0	13.8	119.5
			45.4		13.8
S 74° W	110		29.6 = 0° 30′		105.7
Yesterday's latitude -			13 12 N		
Present latitude -			12 42 N		

IV. The course per compass from Greigsness to the May is SW ¼ S, distance 58 miles; from the May to the Staples S b E ¾ E, 44 miles; and from the Staples to Flamborough Head S b E, 110 miles. Required the course per compass, and distance from Greigsness to Flamborough Head?

Courses.	Dist.	Diff. of Latitude. N	Diff. of Latitude. S	Departure. E	Departure. W
SW ¼ S	58	—	43.0	—	38.9
S b E ¾ E	44	—	41.4	14.8	—
S b E	110	—	107.9	21.5	—
			192.3	36.3	38.9
					36.3
					2.6

Hence the course per compass is S 1° E, and distance 110 miles.

Parallel Sailing.

CHAP. IV. *Of Parallel Sailing.*

THE figure of the earth is spherical, and the meridians gradually approach each other, and meet at the poles. The difference of longitude between any two places is the angle at the pole contained between the meridians of those places; or it is the arch of the equator intercepted between the meridians of the given places; and the meridian distance between two places in the same parallel, is the arch thereof contained between their meridians. It hence follows, that the meridian distance, answering to the same difference of longitude, will be variable with the latitude of the parallel upon which it is reckoned; and the same difference of longitude will not answer to a given meridian distance when reckoned upon different parallels.

Parallel sailing is therefore the method of finding the distance between two places lying in the same parallel where longitudes are known; or, to find the difference of longitude answering to a given distance, run in an east or west direction. This sailing is particularly useful in making low or small islands.

In order to illustrate the principles of parallel sailing, let CABP (fig. 9.) represent a section of one part of the earth, the arch ABP being part of a meridian; CA the equatorial; and CP the polar semiaxis. Also let B be the situation of any given place on the earth; and join BC, which will be equal to CA or CP (A). The arch AB, or angle ACB, is the measure of the latitude of the place B; and the arch BP, or angle BCP, is that of its complement. If BD be drawn from B perpendicular to CP, it will represent the cosine of latitude to the radius BC or CA. Plate cccxxxvii.

Now since circles and similar portions of circles are in the direct ratio of their radii; therefore,

As radius
Is to the cosine of latitude;
So is any given portion of the equator
To a similar portion of the given parallel.

(A) This is not strictly true, as the figure of the earth is that of an oblate spheroid; and therefore the radius of curvature is variable with the latitude. The difference between CA and CP, according to Sir Isaac Newton's hypothesis, is about 17 miles.

Parallel Sailing.

But the difference of longitude is an arch of the equator; and the distance between any two places under the same parallel, is a similar portion of that parallel.

Hence R : cosine latitude :: Diff. longitude : Distance.

And by inversion,

Cosine latitude : R :: Distance : Diff. of longitude.

Also,

Diff. of longitude : Distance :: R : cos. latitude.

Prob. I. Given the latitude of a parallel, and the number of miles contained in a portion of the equator, to find the miles contained in a similar portion of that parallel.

Example I. Required the number of miles contained in a degree of longitude in latitude 55° 58′?

By Construction.

Plate ccclxxxvii.

Draw the indefinite right line AB (fig. 10.); make the angle BAC equal to the given latitude 55° 58′, and AC equal to the number of miles contained in a degree of longitude at the equator, namely 60: from C draw CB perpendicular to AB; and AB being measured on the line of equal parts, will be found equal to 33.5, the miles required.

By Calculation.

As radius - - -		10.00000
is to the cosine of latitude,	55° 58′	9.74794
so is miles in a deg. of long. at eq.	60	1.77815
to the miles in deg. in a given par.	33.58	1.52609

By Inspection.

To 56°, the nearest degree to the given latitude, and distance 60 miles, the corresponding difference of latitude is 33.6, which is the miles required.

By Gunter's Scale

The extent from 90° to 34°, the complement of the given latitude on the line of sines, will reach from 60 to 33.6 on the line of numbers.

There are two lines on the other side of the scale, with respect to Gunter's line, adapted to this particular purpose; one of which is intitled *chords*, and contains the several degrees of latitude: The other, marked M. L. signifying *miles of longitude*, is the *line of longitude*, and shows the number of miles in a degree of longitude in each parallel. The use of these lines is therefore obvious.

Example II. Required the distance between Treguier in France, in longitude 3° 14′ W, and Gaspey Bay, in longitude 64° 27′ W, the common latitude being 48° 47′ N?

Longitude Treguier -	3° 14′ W	
Longitude Gaspey Bay	64 27 W	
Difference of longitude	61 13=3673′	
As radius - -		10.00000
is to the cosine of latitude,	48° 47′	9.81882
so is the difference of longitude	3673	3.56502
to the distance - -	2420	3.38384

Prob. II. Given the number of miles contained in a portion of a known parallel, to find the number of miles in a similar portion of the equator.

Example. A ship from Cape Finisterre, in latitude 42° 52′ N, and longitude 9° 17′ W, sailed due west 342 miles. Required the longitude come to?

By Construction.

Draw the straight line AB (fig. 11.) equal to the given distance 342 miles, and make the angle BAC equal 42° 52′, the given latitude: from B draw BC perpendicular to AB, meeting AC in C; then AC applied to the scale will measure 466½, the difference of longitude required.

Parallel Sailing.

By Calculation.

As radius - -		10.00000
is to the secant of latitude,	42° 52′	10.13493
so is the distance - -	342	2.53403
to the difference of longitude	466.6	2.66896

By Inspection.

The nearest degree to the given latitude is 43°; under which, and opposite to 171, half the given distance in a latitude column, is 234 in a distance column, which doubled gives 468, the difference of longitude.

If the proportional part answering to the difference between the given latitude and that used be applied to the above, the same result with that found by calculation will be obtained.

By Gunter's Scale.

The extent from 47° 8′, the complement of latitude to 90° on the line of sines, being laid the same way from the distance 342, will reach to the difference of longitude 466½ on the line of numbers.

Longitude Cape Finisterre -	9° 17′W
Difference of longitude -	7 47 W
Longitude come to - -	17 4 W

Prob. III. Given the number of miles contained in any portion of the equator, and the miles in a similar portion of a parallel, to find the latitude of that parallel.

Example. A ship sailed due east 358 miles, and was found by observation to have differed her longitude 8° 42′. Required the latitude of the parallel?

By Construction.

Make the line AB (fig. 12.) equal to the given distance; to which let BC be drawn perpendicular, with an extent equal to 522′, the difference of longitude; describe an arch from the centre A cutting BC in C; then the angle BAC being measured by means of the line of chords, will be found equal to 46°½, the required latitude.

By Calculation.

As the distance -	358	2.55388
is to the difference of longitude,	522	2.71767
so is radius - - -		10.00000
to the secant of the latitude	46° 42′	10.16379

By Inspection.

As the difference of longitude and distance exceed the limits of the table, let therefore the half of each be taken; these are 261 and 179 respectively. Now, by entering the table with these quantities, the latitude will be found to be between 46 and 47 degrees. Therefore, to latitude 46°, and distance 261 miles, the corresponding difference of latitude is 181′.3, which exceeds the half of the given distance by 2′.3. Again, to latitude 47°, and distance 261, the difference of latitude is 178′.0, being 1′.0 less than the half of that given: therefore the change of distance answering to a change of 1° of latitude is 3′.3.

Now, as 3′.3 : 2′.3 :: 1° : 42′

Hence the latitude required is 46° 42′.

Parallel Sailing

By Gunter's Scale.

The extent from 522 to 358 on the line of numbers, will reach from 90° to about 43°$\frac{1}{3}$, the complement of which 46$\frac{2}{3}$ is the latitude required?

PROB. IV. Given the number of miles contained in the portion of a known parallel, to find the length of a similar portion of another known parallel.

EXAMPLE. From two parts in latitude 33° 58′ N, distance 348 miles, two ships sail directly north till they are in latitude 48° 23′ N. Required their distance?

By Construction.

Plate CCCXXXVII.

Draw the lines CB, CE (fig. 13.), making angles with CP equal to the complements of the given latitudes, namely, 56° 2′ and 41° 37′ respectively: make BD equal to the given distance 348 miles, and perpendicular to CP; now from the centre C, with the radius CB, describe an arch intersecting CE in E; then EF drawn from the point E, perpendicular to CP, will represent the distance required; and which being applied to the scale, will measure 278$\frac{1}{2}$ miles.

By Calculation.

As the cosine of the latitude left	33° 58′	9.91874
is to the cosine of the latitude come to -	48 23	9.82226
so is the given distance -	348	2.54158
to the distance required -	278.6	2.44510

By Inspection.

Under 34°, and opposite to 174, half the given distance in a latitude column is 210 in a distance column; being half the difference of longitude answering thereto. Now, find the difference of latitude to distance 210 miles over 48° of latitude, which is 140′.5; from which 1′.1 (the proportional part answering to 23 minutes of latitude) being abstracted, gives 139′.8, which doubled is 278′.8, the distance required.

By Gunter's Scale.

The extent from 56° 2′, the complement of the latitude left, to 41° 37′, the complement of that come to on the line of sines, being laid the same way from 348, will reach to 278$\frac{1}{2}$, the distance sought on the line of numbers.

PROB. V. Given a certain portion of a known parallel, together with a similar portion of an unknown parallel, to find the latitude of that parallel.

EXAMPLE. Two ships, in latitude 56° 0′ N, distant 180 miles, sail due south; and having come to the same parallel, are now 232 miles distant. The latitude of that parallel is required?

By Construction.

Make DB (fig. 14.) equal to the first distance 180 miles, DM equal to the second 232, and the angle DBC equal to the given latitude 56°; from the centre C, with the radius CB, describe the arch BE; and through M draw ME parallel to CD, intersecting the arch BE in E, join EC and draw EF perpendicular to CD: then the angle FEC will be the latitude required; which being measured, will be found equal to

By Calculation

As the distance on the known parallel - -	180	2.25527
is to the distance on that required	232	2.36549
so is the cosine of the latitude left	56° 0′	9.74756
to the cosine of the latitude come to - -	43 53	9.85778

Middle Latitude Sailing.

By Inspection.

To latitude 56°, and half the first distance 90 in a latitude column, the corresponding distance is 161, which is half the difference of longitude. Now 161, and 116 half the second distance, are found to agree between 43 and 44 degrees; therefore, to latitude 43° and distance 161, the corresponding difference of latitude is 117′.7; the excess of which above 116′ is 1′.7: and to latitude 44°, and distance 161, the difference of latitude is 115′.8: hence 117.7—115.8 = 1′.9, the change answering to a change of 1° of latitude.

Therefore 1′.9 : 1′.7 : : 1° : 53′

Hence the latitude is 43° 53′.

By Gunter's Scale.

The extent from 180 to 232 on the line of numbers, being laid in the same direction on the line of sines, from 34°, the complement of the latitude sailed from, will reach to 46° 7′, the complement of the latitude come to.

CHAP. V. *Of Middle Latitude Sailing.*

THE earth is a sphere, and the meridians meet at the poles; and since a rhumb-line makes equal angles with every meridian, the line a ship describes is therefore that kind of a curve called a *spiral*.

Let AB (fig. 15.) be any given distance sailed upon an oblique rhumb, PBN, PAM the extreme meridians, MN a portion of the equator, and PCK, PEL two meridians intersecting the distance AB in the points CE infinitely near each other. If the arches BS, CD, and AR, be described parallel to the equator, it is hence evident, that AS is the difference of latitude, and the arch MN of the equator the difference of longitude, answering to the given distance AB and course PAB.

Now, since CE represents a very small portion of the distance AB, DE will be the correspondent portion of a meridian: hence the triangle EDC may be considered as rectilineal. If the distance be supposed to be divided into an infinite number of parts, each equal to CE, and upon these, triangles be constructed whose sides are portions of a meridian and parallel, it is evident these triangles will be equal and similar; for, besides the right angle, and hypothenuse which is the same in each, the course or angle CED is also the same. Hence, by the 12th of V. Euc. the sum of all the hypothenuses CE, or the distance AB, is to the sum of all the sides DE, or the difference of latitude AS, as one of the hypothenuses CE is to the corresponding side DE. Now, let the triangle GIH (fig. 16.) be constructed similar to the triangle CDE, having the angle G equal to the course: then as GH : GI : : CE : DC : : AB : AS.

Hence, if GH be made equal to the given distance AB, then GI will be the corresponding difference of latitude.

In like manner, the sum of all the hypothenuses CE, or the distance AB, is to the sum of all the sides

Middle Latitude Sailing.

CD, as CE is to CD, or as GH to HI, becauſe of the ſimilar triangles.

The ſeveral parts of the ſame rectilineal triangle will therefore repreſent the courſe, diſtance, difference of latitude, and departure.

Although the parts HG, GI, and angle G of the rectilineal triangle GIH, are equal to the correſponding parts AB, AS, and angle A, of the triangle ASB upon the ſurface of the ſphere; yet HI is not equal to BS, for HI is the ſum of all the arcs CD; but CD is greater than OQ, and leſs than ZX: therefore HI is greater than BS, and leſs than AR. Hence the difference of longitude MN cannot be inferred from the departure reckoned either upon the parallel ſailed from or on that come to, but on ſome intermediate parallel TV, ſuch that the arch TV is exactly equal to the departure: and in this caſe the difference of longitude would be eaſily obtained. For TV is to MN as the ſine PT to the ſine PM; that is, as the coſine of latitude is to the radius.

The latitude of the parallel TV is not, however, eaſily determined with accuracy; various methods have therefore been taken in order to obtain it nearly, with as little trouble as poſſible: firſt, by taking the arithmetical mean of the two latitudes for that of the mean parallel: ſecondly, by uſing the arithmetical mean of the coſines of the latitudes: thirdly, by uſing the geometrical mean of the coſines of the latitudes: and laſtly, by employing the parallel deduced from the mean of the meridional parts of the two latitudes. The firſt of theſe methods is that which is generally uſed.

In order to illuſtrate the computations in middle latitude ſailing, let the triangle ABC (fig. 17.) repreſent a figure in plain ſailing, wherein AB is the difference of latitude, AC the diſtance, BC the departure, and the angle BAC the courſe. Alſo let the triangle DBC be a figure in parallel ſailing, in which DC is the difference of longitude, BC the meridian diſtance, and the angle DCB the middle latitude. In theſe triangles there is therefore one ſide BC common to both; and that triangle is to be firſt reſolved in which two parts are given, and there the unknown parts of the other triangle will be eaſily obtained.

Plate CCCXXXVII.

Prob. I. Given the latitudes and longitudes of two places, to find the courſe and diſtance between them.

Example. Required the courſe and diſtance from the iſland of May, in latitude 56° 12′ N, and longitude 2° 37′ W, to the Naze of Norway, in latitude 57° 50′ N, and longitude 7° 27′ E?

Latitude Iſle of May -	56° 12′ N	-	56° 12′
Latitude Naze of Norway	57 50 N	-	57 50
Difference of latitude -	1. 38 = 98′		114. 2
Middle latitude - -	-		57. 1
Longitude Iſle of May -	2 37 W		
Longitude Naze of Norway -	7 27 E		
Difference of longitude -	10 4 = 604′		

Middle Latitude Sailing.

By Conſtruction.

Draw the right line AD (fig. 18.) to repreſent the meridian of the May; with the chord of 60° deſcribe the arch *m n*, upon which lay off the chord of 32° 59′, the complement of the middle latitude from *m* to *n*: from D through *n* draw the line DC equal to 604′, the difference of longitude, and from C draw CB perpendicular to AC: make BA equal to 98′, the difference of latitude, and join AC; which applied to the ſcale will meaſure 343 miles, the diſtance ſought: and the angle A being meaſured by means of the line of chords, will be found equal to 73° 24′, the required courſe.

By Calculation.

To find the courſe (B).

As the difference of latitude -	98′	-	1.99123
is to the difference of latitude	604	-	2.78104
ſo is the coſine of middle latitude - -	57° 1′		9.73591
to the tangent of the coſine	73 24		10.52572

To find the diſtance.

As radius - - -			10.00000
is to the ſecant of the courſe	73° 24′		10.54411
ſo is the difference of latitude	98′		1.99123
to the diſtance -		343	2.53534

By Inſpection.

To middle latitude 57°, and 151 one-fourth of the difference of longitude in a diſtance column, the correſponding difference of latitude is 82.2.

Now 24.5, one-fourth of the difference of latitude, and 82.2, taken in a departure column, are found to agree neareſt on table marked $6\frac{1}{2}$ points at the bottom, which is the coſine; and the correſponding diſtance $85\frac{1}{4}$ multiplied by 4 gives 343 miles, the diſtance.

By Gunter's Scale.

The extent from 98 the difference of latitude, to 604 the difference of longitude on numbers, being laid the ſame way from 33°, the complement of the middle latitude on ſines, will reach to a certain point beyond the termination of the lines on the ſcale. Now the extent between this point and 90° on ſines, will reach from 45° to 73° 24′, the courſe on the line of tangents. And the extent from 73° 24′ the courſe, to 33° the complement of the middle latitude on the line of ſines, being laid the ſame way from 604 the difference of longitude, will reach to 343 the diſtance on the line of numbers.

The true courſe, therefore, from the iſland of May to the Naze of Norway is 73 N, 24 E, or ENE$\frac{1}{4}$E nearly; but as the variation at the May is $2\frac{1}{4}$ points weſt,

(B) For R. : coſine Mid. lat. : : Diff. of long. : Departure;
And diff. of lat. : Dep. : : R. : Tangent courſe.
Hence diff. of lat. : coſine mid. lat. : : diff. of long. : tang. courſe;
Or diff. of lat. : diff. of long. : : coſine mid. lat. : tang. courſe.

Middle Latitude Sailing.

west, therefore the course *per* compass from the May is E $\frac{1}{4}$S.

PROB. II. Given one latitude, course, and distance sailed, to find the other latitude and difference of longitude.

EXAMPLE. A ship from Brest, in latitude 48° 23′N. and longitude 4° 30′ W. sailed SW$\frac{1}{4}$W 238 miles. Required the latitude and longitude come to?

By *Construction.*

Plate cccxxxvii.

With the course and distance construct the triangle ABC (fig. 17.), and the difference of latitude AB being measured, will be found equal to 142 miles: hence the latitude come to is 46° 1′ N, and the middle latitude 47° 12′. Now make the angle DCB equal to 47° 12′; and DC being measured, will be the difference of longitude: hence the longitude come to is

By *Calculation,*

To find the difference of latitude,

As radius - - -			10.00000
is to the co-sine of the course,		$4\frac{1}{4}$	9.77503
so is the distance, -		238	2.37658
to the difference of latitude		141.8	2.15161
Latitude of Brest,	48° 23′ N.		48° 23′ N.
Difference of Lat.	2 22 S.	half	1 11 S.
Lat. come to	46° 1′ N.	Mid Lat.	47 12

To find the difference of longitude (D).

As the co-sine of Mid. Lat.	47° 12′	9.83215
is to the sine of the course	$4\frac{1}{4}$ points	9.90483
so is the distance	238	2.37658
to the difference of longitude	281.3	2.44926
Longitude of Brest -	-	4° 30′W.
Difference of longitude	-	4 41W.
Longitude come to	- -	9 11W.

By *Inspection.*

To the course $4\frac{1}{4}$ points, and distance 238 miles, the difference of latitude is 141.8, and the departure 191.1. Hence the latitude come to is 46° 1′N, and middle latitude 47° 12′ Then to middle latitude 47° 12′, and departure 191.1 in a latitude column, the corresponding distance is 281′, which is the difference of longitude.

By Gunter's Scale.

The extent from 8 points to $3\frac{1}{4}$ points, the complement of the course on fine rhumbs, being laid the same way from the distance 238, will reach to the difference of latitude 142 on the line of numbers; and the extent from 42° 48′ the complement of the middle latitude, to 53° 26′, the course on the line of sines will reach from the distance 238 to the difference of longitude 281 on numbers.

PROB. III. Given both latitudes and course, required the distance and difference of longitude?

EXAMPLE. A ship from St Antonio, in latitude 17° 0′ N, and longitude 24° 25′ W, sailed NW, $\frac{1}{4}$ N, till by observation her latitude is found to be 28° 34′N. Required the distance sailed, and longitude come to? Middle Latitude Sailing.

Latitude St Antonio	17° 0N.	17° 0′N.
Latitude by observation	28 34 N.	28 34 N.
Difference of lat.	11 34=694m	45 34
	Middle lat.	22 47

By Construction.

Construct the triangle ABC (fig. 19), with the given course and difference of latitude, and make the angle BCD equal to the middle latitude. Now the distance AC and difference of longitude DC being measured, will be found equal to 864 and 558 respectively.

By Calculation.

To find the distance.

As radius, - -		10.00000
Is to the secant of the course	$3\frac{1}{4}$ points	10.09517
So is the difference of lat.	694	2.84136
To the distance -	864	2.93653

To find the difference of longitude.

As the cosine of middle latitude	22° 47′	9.96472
Is to the tangent of the course	$3\frac{1}{4}$ points	9.87020
So is the difference of latitude	694	2.84136
To the difference of longitude	558.3	2.74684
Longitude of St Antonio -		24° 25′W.
Difference of longitude, -		9 18W.
Longitude come to - -		33 43W.

By Inspection.

To course $3\frac{1}{4}$ points, and difference of latitude 231.3 one third of that given, the departure is 171.6. and distance 288, which multiplied by 3 is 864 miles.

Again to the middle latitude 22° 47′, or 23°, and departure 171.6 in a latitude column, the distance is 186, which multiplied by 3 is 558, the difference of longitude.

By Gunter's Scale.

The extent from $4\frac{1}{4}$ points, the complement of the course, to 8 points on the line of fine rhumbs, will reach from the difference of latitude 694 to the distance 864 on numbers; and the extent from the course 36° 34′ to 67° 13′, the complement of middle latitude on sines, will reach from the distance 864 to the difference of longitude 558 on numbers.

PROB. IV. Given one latitude, course, and departure, to find the other latitude, distance, and difference of longitude.

EXAMPLE. A ship from latitude 26° 30′ N. and longitude 45° 30′ W. sailed NE$\frac{1}{4}$N. till her departure is 216 miles. Required the distance run, and latitude and longitude come to?

By Construction.

With the course and departure construct the triangle ABC (fig. 20.), and the distance and difference of latitude being measured, will be found equal to 340 and 263 respectively. Hence the latitude come to is 30° 53′ and middle latitude 28° 42′. Now make the angle BCD equal to the middle latitude, and the difference of longitude DC applied to the scale will measure 246′.

By

(D) This proportion is obvious, by considering the whole figure as an oblique angled triangle.

Middle Latitude Sailing.

By Calculation.

To find the distance.

As the fine of the courfe	3½ points	9.80236
Is to radius - - -		10.00000
So is the departure	216	2.33445
To the diftance -	340.5	2.53209

To find the difference of latitude.

As the tangent of the courfe	3½ points	9.91417
is to radius -	-	10.00000
fo is the departure -	216	2.33445
to the difference of lat.	263.2	2.42028
Latitude failed from	26° 30′N.	26° 30′N.
Difference of latitude	4 23 N. half	2 12N.
Latitude come to	30 53N. Mid.lat.	28 42

To find the difference of longitude.

As radius - -		10.00000
is to the fecant of the mid. lat.	28° 42′	10.05693
fo is the departure -	216	2.33445
to the difference of longitude	246.2	2.39138
Longitude left, - -		45° 30′W.
Difference of longitude - -		4 6 E.
Longitude come to - -		41 24 W.

By Inſpection.

Under the courſe 3½ points, and oppoſite to 108 half the departure, the diſtance is 170, and difference of latitude 131½; which doubled, give 340 and 263 for the diſtance and difference of latitude reſpectively.

Again, to middle latitude 28° 42′, and departure 108, the diſtance is 123; which doubled is 246 the difference of longitude.

By Gunter's Scale.

The extent from the courſe 3½ points, on fine rhumbs, to the departure 216 on numbers, will reach from 8 points on fine rhumbs to about 340, the diſtance on numbers; and the ſame extent will reach from 4½ points, the complement of the courſe, to 263, the difference of latitude on numbers; and the extent from 61° 18′ the complement of the middle latitude, to 90° on fines, will reach from the departure 216 to the difference of longitude 246 on numbers.

Prob. V. Given both latitudes and diſtance; to find the courſe and difference of longitude.

Example. From Cape Sable, in latitude 43° 24′N. and longitude 65° 39′W. a ſhip ſailed 246 miles on a direct courſe between the ſouth and eaſt, and is then by obſervation in latitude 40° 48′N. Required the courſe and longitude in?

Latitude Cape Sable,	43° 24′N.	43° 24′N.
Latitude by obſervation,	40 48N.	40 48 N.
Difference of latitude,	2 36=156′	24 12
Middle latitude	42 6	

By Conſtruction.

Plate CCCXXXV. Make AB (fig. 21.) equal to 156 miles; draw BC perpendicular to AB, and make AC equal to 246 miles. Draw CD, making with CB an angle of 42° 6′ the middle latitude. Now DC will be found to meaſure 256, and the courſe or angle A will meaſure 50° 39′.

Middle Latitude Sailing.

By Calculation.

To find the courſe.

As the diſtance -	246	2.39093
is to the difference of latitude	156	2.19312
ſo is radius, - - -		10.00000
to the coſine of the courſe	50° 39′	9.80219

To find the difference of longitude.

As the coſine of middle latitude	42° 6′	9.87039
is to the ſine of the courſe	50 39	9.88834
ſo is the diſtance -	246	2.39093
to the difference of longitude	256.4	2.40888
Longitude Cape Sable, -		65° 39′W.
Difference of longitude - -		4 16 E.
Longitude come to -		61 23 W.

By Inſpection.

The diſtance 246, and difference of latitude 156, are found to correſpond above 4½ points, and the departure is 190.1. Now, to the middle latitude 42°, and departure 190.1 in a latitude column, the correſponding diſtance is 256, which is the difference of longitude required.

By Gunter's ſcale.

The extent from 246 miles, the diſtance to 156, the difference of latitude on numbers, will reach from 90° to about 39°⅓, the complement of the courſe on the line of fines: and the extent from 48°, the complement of the middle latitude, to 50°⅔, the courſe on fines, will reach from the diſtance 246m to the difference of longitude 256m on numbers.

Prob. VI. Given both latitudes and departure; fought the courſe, diſtance, and difference of longitude.

Example. A ſhip from Cape St Vincent, in latitude 37° 2′N. longitude 9° 2′W. ſails between the ſouth and weſt; the latitude come to is 18° 16′N, and departure 838 miles. Required the courſe and diſtance run, and longitude come to?

Latitude Cape St Vincent,	37° 2′N.	37° 2′
Latitude come to -	18 16 N.	18 16
Difference of latitude	18 46=1126	55 18
Middle latitude		27 39

By Conſtruction.

Make AB (fig. 22.) equal to the difference of latitude 1126 miles, and BC equal to the departure 838, and join AC; draw CD ſo as to make an angle with CB equal to the middle latitude 27° 39′. Then the courſe being meaſured on chords is about 36°⅔, and the diſtance and difference of longitude, meaſured on the line of equal parts, are found to be 1403 and 946 reſpectively.

By Calculation.

To find the courſe.

As the difference of latitude	1126	3.05154
is to the departure -	838	2.92324
ſo is radius -	-	10.00000
to the tangent of the courſe	36° 39′	9.87170

To

Middle Latitude Sailing.

To find the distance.

As radius - - -		10.00000
is to the secant of the course	36° 39′	10.09566
so is the difference of latitude	1126	3.05154
to the distance -	1403	3.14720

To find the difference of longitude.

As radius - -		10.00000
is to the secant of the mid. lat.	27° 39′	10.05266
so is the departure -	838	2.92324
to the difference of longitude	946	2.97590
Longitude Cape St Vincent - -		9° 2′ W.
Difference of longitude - -		15 46 W.
Longitude come to - -		24 48 W.

By Inspection.

One-tenth of the difference of latitude 112.6, and of the departure 83.8, are found to agree under $3\frac{1}{2}$ points, and the corresponding distance is 140, which multiplied by 10 gives 1400 miles. And to middle latitude $27°\frac{2}{3}$, and 209.5 one-fourth of the departure in a latitude column, the distance is 236.5; which multiplied by 4 is 946, the difference of longitude.

By Gunter's Scale.

The extent from the difference of latitude 1126 to the departure 838 on numbers, will reach from 45° to $36°\frac{2}{3}$ the course on tangents; and the extent from $53°\frac{1}{3}$ the complement of the course to 90° on sines, will reach from 1126 to 1403 the distance on numbers. Lastly, the extent from $62°\frac{1}{3}$ the complement of the middle latitude, to 90° on sines, will reach from the departure 838 to the difference of longitude 946 on numbers.

Prob. VII. Given one latitude, distance, and departure, to find the other latitude, course, and difference of longitude.

Example. A ship from Bourdeaux, in latitude 44° 50′ N, and longitude 0° 35′ W, sailed between the north and west 374 miles, and made 210 miles of westing. Required the course and latitude and longitude, come to?

By Construction.

Plate CXXXVII. With the given distance and departure mark the triangle ABC (fig. 23.) Now the course being measured on the line of chords is about $34°\frac{1}{6}$, and the difference of latitude on the line of numbers is 309 miles: hence the latitude come to, is 49° 59′ N, and middle latitude 47° 25′. Then make the angle BCD equal to 47° 25′, and DC measured will be 310 miles, the difference of longitude.

By Calculation.

To find the course.

As the distance -	374 -	2.57287
is to the departure -	210 -	2.32222
so is radius - - -		10.00000
to the sine of the course	34° 10′	9.74935

To find the difference of latitude.

As radius - - -		10.00000
is to the cosine of the course	34° 10′	9.91772
so is the distance -	374	2.57287
to the difference of latitude	309.4	2.49059

Middle Latitude Sailing.

Latitude Bourdeaux	44° 50′ N	-	44° 50′
Difference of latitude	5 9 N	half -	2 35
Latitude come to	49 59 N	Mid. lat.	47 25

To find the difference of longitude.

As radius - -		10.00000
is to the secant of middle latitude -	47° 25′ -	10.16963
so is the departure -	210 -	2.32222
to the difference of longitude	310.3 -	2.49185
Longitude of Bourdeaux -		0° 35′ W
Difference of longitude - -		5 10 W
Longitude in - -		5 45 W

By Inspection.

The half of the distance 187, and of the departure 105, are found to agree nearest under 34°, and the difference of latitude answering thereto is 155; which doubled is 310 miles.

Again, to middle latitude 47° 25′, and departure 105 in a latitude column, the corresponding distance is 155 miles, which doubled is 310 miles, the difference of longitude.

By Gunter's Scale.

The extent from the distance 374 miles to the departure 210 miles on the line of numbers, will reach from 90° to 34° 10′, the course on the line of sines; and the extent from 90° to 55° 50′, the complement of the course on sines, will reach from the distance 374 to the difference of latitude 309 miles on numbers.

Again, the extent from 42° 35′, the complement of the middle latitude, to 90° on sines, will reach from the departure 210 to the difference of longitude 310 on numbers.

Prob. VIII. Given one latitude, departure, and difference of longitude, to find the other latitude, course, and distance.

Example. A ship from latitude 54° 56′ N, longitude 1° 10′ W, sailed between the north and east, till by observation she is found to be in longitude 5° 26′ E, and has made 220 miles of easting. Required the latitude come to, course, and distance run?

Longitude left - -		1° 10′ W
Longitude come to -		5 26 E
Difference of longitude -		6 36 = 396

By Construction.

Make BC (fig. 24.) equal to the departure 220, and CD equal to the difference of longitude 396:— then the middle latitude BCD being measured, will be found equal to 56° 15′: hence the latitude come to is 57° 34′, and difference of latitude 158°. Now make AB equal to 158, and join AC, which applied to the scale, will measure 271 miles. Also the course BAC being measured on chords will be found equal $54\frac{1}{2}$.

By Calculation.

To find the middle latitude.

As the departure -	220 -	2.34242
is to the difference of longitude - -	396 -	2.59769
so is radius - -		10.00000

Middle Latitude Sailing.

to the secant of the middle latitude -	56° 15′	10.25527
Double the middle latitude	112 30	
Latitude left -	54 56	
Latitude come to -	57 34	
Difference of latitude -	2 38 = 158	

To find the course.

As the difference of latitude	158 -	2.19866
is to the departure -	220 -	2.34242
so is radius -	-	10.00000
to the tangent of the course	54° 19′	10.14376

To find the distance.

As radius -	-	10.00000
is to the secant of the course	54° 19′	10.23410
so is the difference of latitude	158 -	2.19866
to the distance -	270.9 -	2.43276

By Inspection.

As the difference of longitude and departure exceed the limits of the tables, let therefore their halves be taken; these are 198 and 110 respectively. Now these are found to agree exactly in the page marked 5 points at the bottom. Whence the middle latitude is 56° 15′, and difference of latitude 158 miles.

Again, the difference of latitude 158 and departure 220 will be found to agree nearly above 54° the course, and the distance on the same line is 271 miles.

By Gunter's Scale.

The extent from the difference of longitude 396 to the departure 220 on numbers, will reach from 90° to 33° 45′, the complement of the middle latitude on lines; and hence the difference of latitude is 158 miles. Now the extent from 158 to 220 on numbers, will reach from 45° to 54° $\frac{1}{3}$ on tangents; and the extent from the complement of the course 35° $\frac{2}{3}$ to 90° on lines, will reach from the difference of latitude 158 to the distance 271 on numbers.

Prob. IX. Given the course and distance sailed, and difference of longitude; to find both latitudes.

Example. A ship from a port in north latitude, sailed SE $\frac{1}{4}$S 438 miles, and differed her longitude 7° 28′. Required the latitude sailed from, and that come to?

By Construction.

Plate CCCXXXVII. With the course and distance construct the triangle ABC (fig. 25.) and make DC equal to 448 the given difference of longitude. Now the middle latitude BCD will measure 48° 58′, and the difference of latitude AB 324 miles: hence the latitude left is 51° 40′, and that come to 46° 16′.

By Calculation.

To find the difference of latitude.

As radius - - -		10.00000
is to the cosine of the course	3 $\frac{3}{4}$ pts. -	9.86979
so is the distance -	438 -	2.64147
to the difference of latitude	324.5 -	2.51126

To find the middle latitude.

As the difference of longitude	448 -	2.65128
is to the distance -	438 -	2.64147
so is the course	3 $\frac{3}{4}$ pts.	9.82708
to the cosine of the middle latitude -	48° 58′ -	9.81727
half difference of latitude	2 42	
Latitude sailed from -	51 40	
Latitude come to -	46 16	

Middle Latitude Sailing.

By Inspection.

To the course 3 $\frac{3}{4}$ points, and half the distance 219 miles, the departure is 147.0, and difference of latitude 162.2; which doubled is 324.4. Again, to half the difference of longitude 224 in a distance column, the difference of latitude is 149.9 above 48°, and 146.9 over 49°.

Now, as 30 : 29 : : 60′ : 58′

Hence the middle latitude is 48° 58′: the latitude sailed from is therefore 51° 40′, and latitude come to 46° 16′.

By Gunter's Scale.

The extent from 8 points to 4 $\frac{1}{4}$ points, the complement of the course on fine rhumbs, will reach from the distance 438 miles to the difference of latitude 3245 on numbers. And the extent from the difference of longitude 448, to the distance 438 on numbers, will reach from the course 42° 11′ to the complement of the middle latitude 41° 2′ on lines. Hence the latitude left is 51° 40′, and that come to 46° 16′.

Prob. X. Given the course, difference of latitude, and difference of longitude; to find both latitudes and distance.

Example. From a port in south latitude a ship sailed SW $\frac{1}{4}$W, and has made 690 miles of difference of latitude, and 20° 38′ of difference of longitude.—Required both latitudes and distance?

By Construction.

Construct the triangle ABC (fig. 26.) with the given course and difference of latitude, and make CD equal to 1228 the difference of longitude. Then AC applied to the scale will measure 1088 miles; and the middle latitude BCD will measure 46° 47′. Hence the latitude left is 41° 2′, and the latitude come to 52° 32′.

By Calculation.

To find the distance.

As radius -	-	10.00000
is to the secant of the course	4 $\frac{1}{4}$ pts.	10.19764
so is the difference of latitude	690 -	2.83885
to the distance -	1088 -	3.03649

To find the middle latitude.

As the difference of longitude	1228 -	3.08920
is to the distance -	1088 -	3.03649
so is the line of the course	4 $\frac{1}{4}$ pts.	9.88819
to the cosine of the middle latitude -	46° 47′	9.83548
Half difference of latitude -	5 45	
Latitude sailed from -	41 2	
Latitude come to -	52 32	

By Inspection.

To the course 4 $\frac{1}{2}$ points, and one-fourth of the given difference of latitude 172.5 the departure is 210.2

Fig. 1.

Fig. 2.

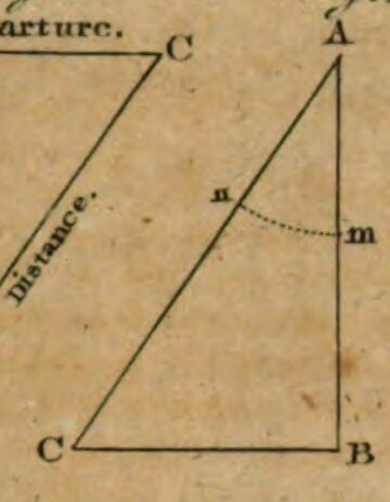


Fig. 3.

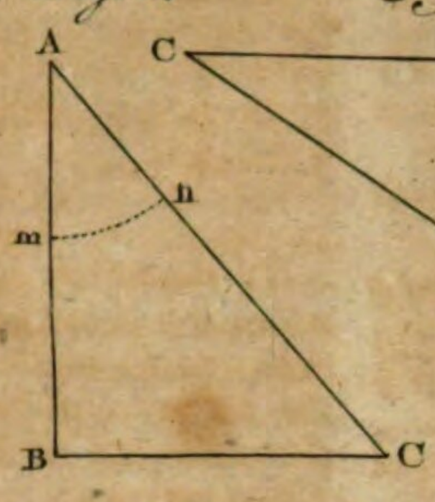
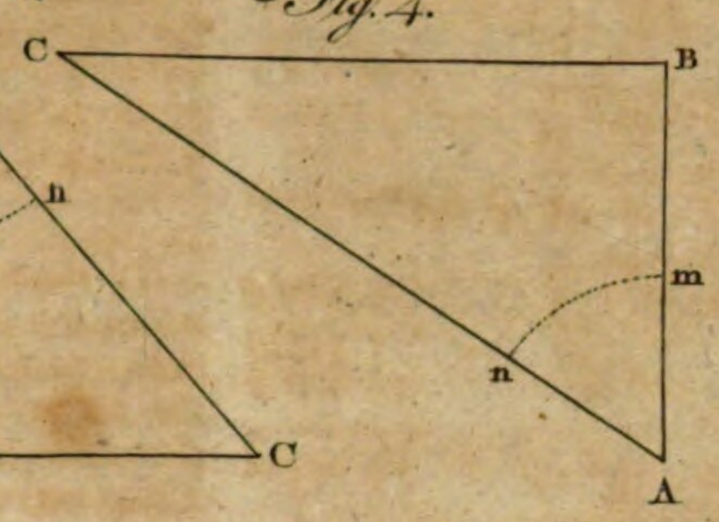


Fig. 4.



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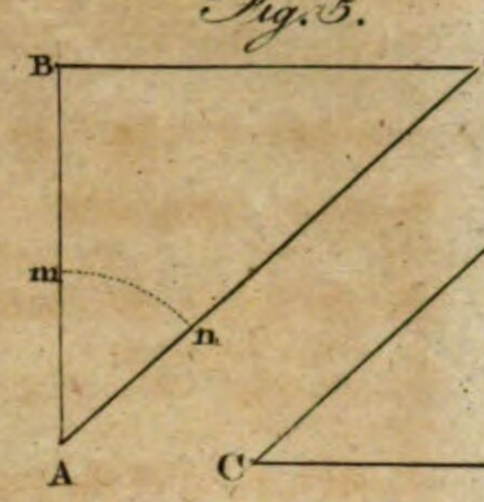


Fig. 6.

Fig. 7.

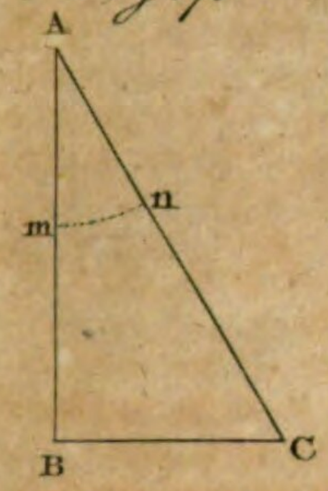


Fig. 8.

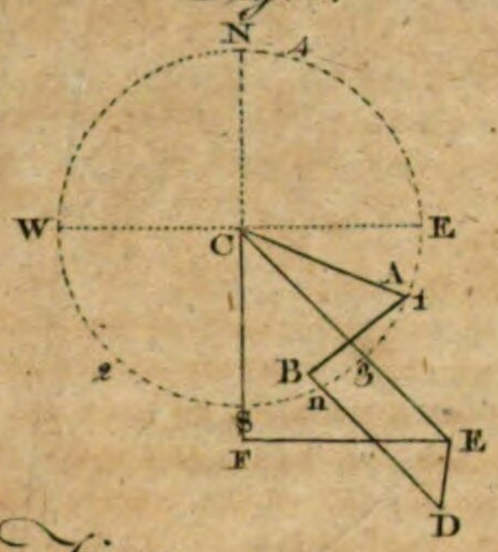


Fig. 9.

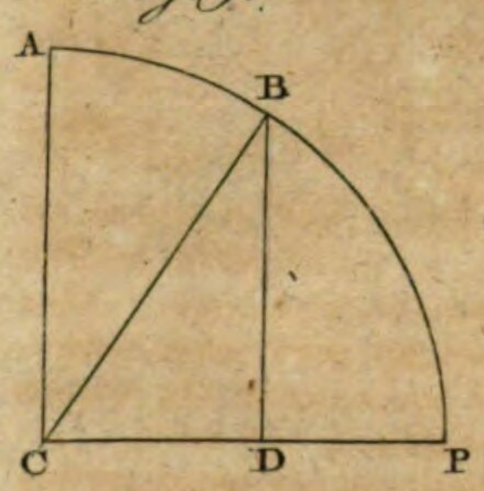
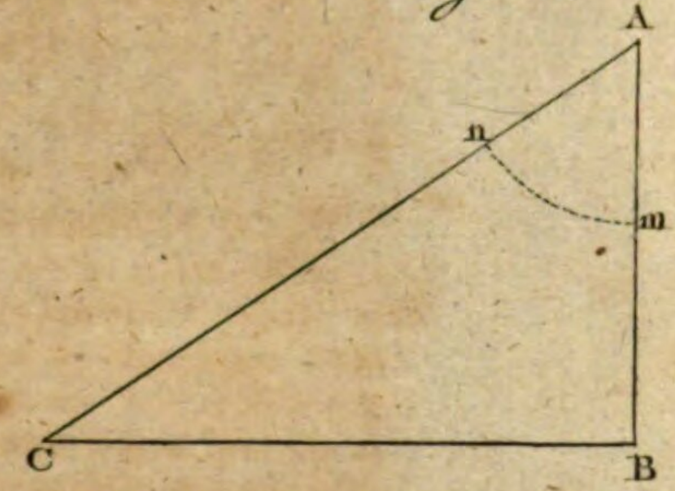


Fig. 10.



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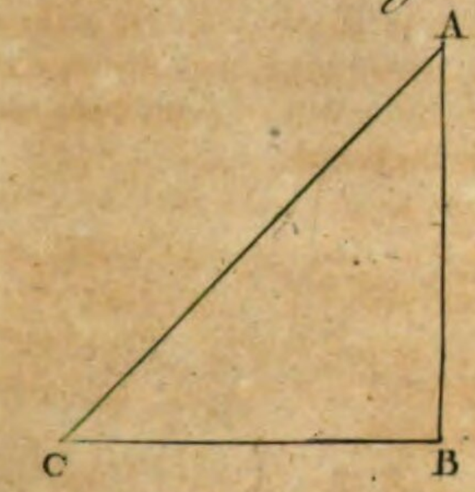


Fig. 12.

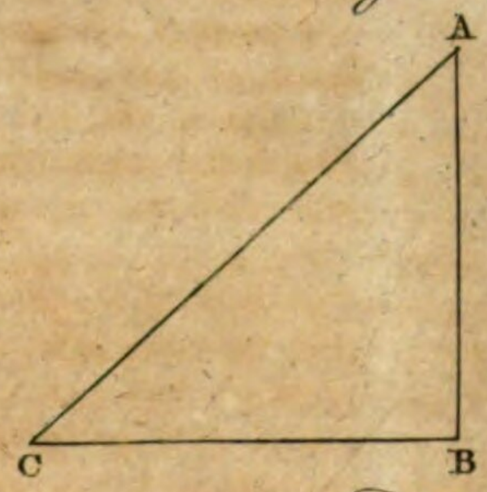


Fig. 13.

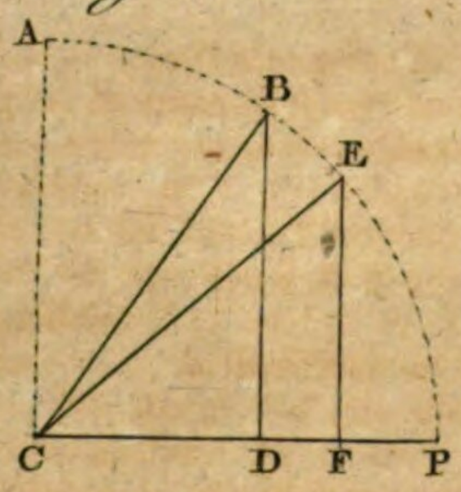


Fig. 14.

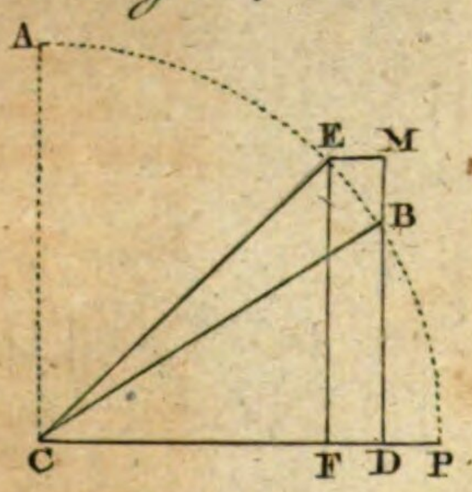


Fig. 15.

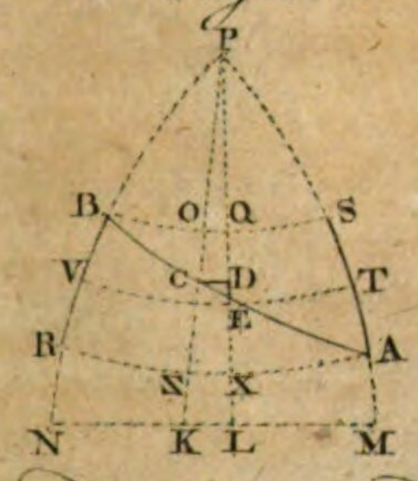


Fig. 16.

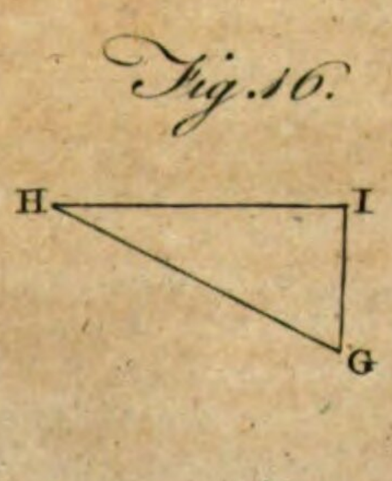


Fig. 17.

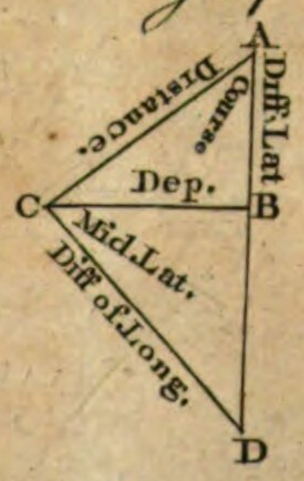
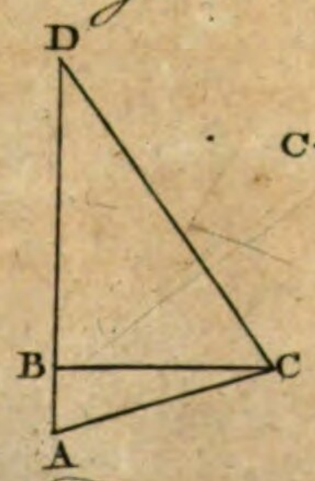


Fig. 18.



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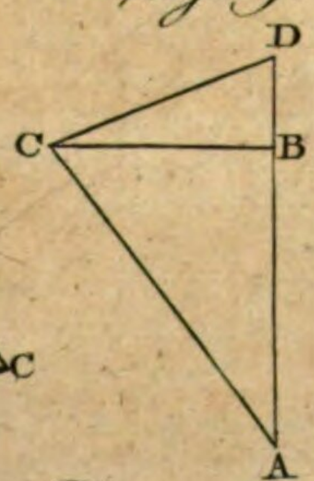
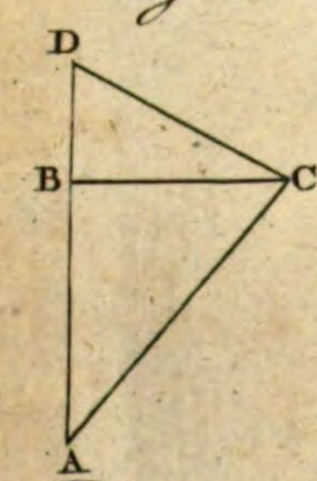


Fig. 20



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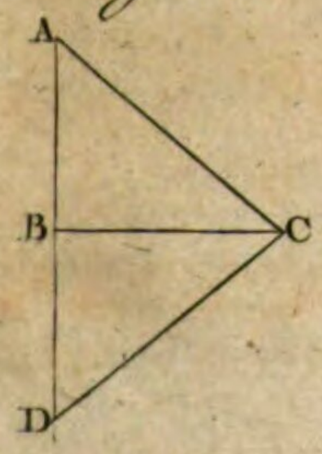

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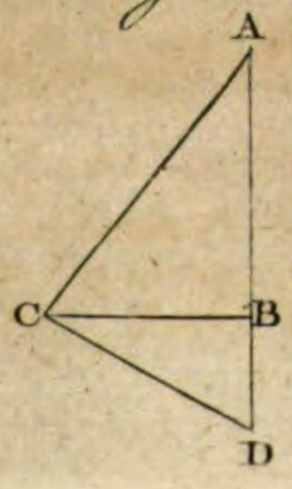

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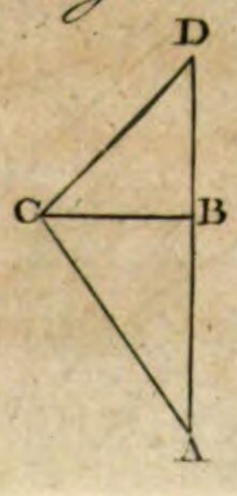

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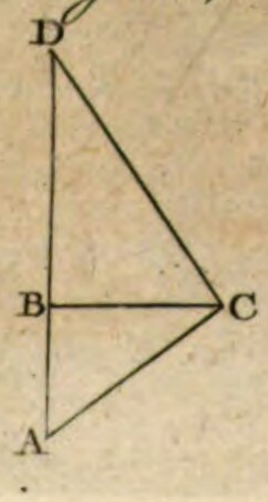

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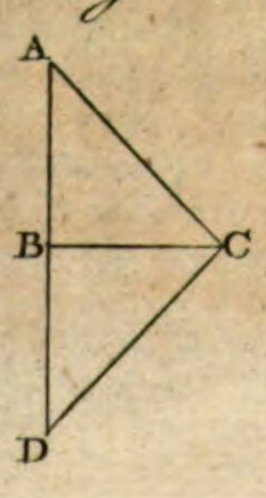


Fig. 26.

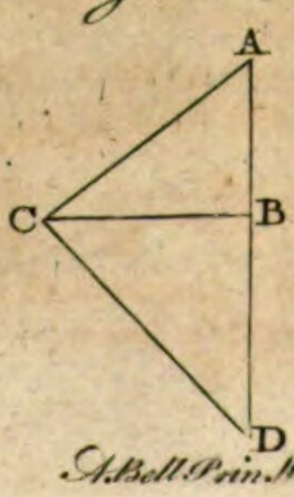
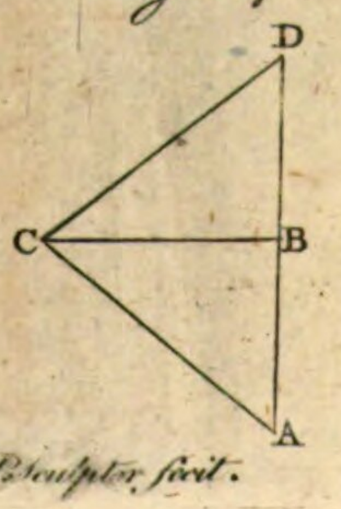


Fig. 27.



A. Bell Prin. Mathematical Sculptor. fecit.

Middle Latitude Sailing.

210.2, and distance 272, which multiplied by 4 is 1088.

Now the middle latitude answering to the difference of longitude 1228, and departure 840.8, or their aliquot parts, will be found as in last problem to be 46° 47′. Hence the latitudes are 41° 2′ and 52° 32′ respectively.

By Gunter's Scale.

The extent from the complement of the course 3½ points to 8 points on fine rhumbs, will reach from the difference of latitude 690 to the distance 1088 miles on numbers; and the extent from the difference of longitude 1228 to the distance 1088 on numbers, will reach from the course 50° 38′ to the complement of the middle latitude 43° 13′ on the line of fines.—Hence both latitudes are found as before.

Prob. XI. Given the distance sailed, difference of latitude, and difference of longitude, to find both latitudes and course.

Example. In north latitude, a ship sailed 458 miles on a direct course between the north and west; and then was found to have differed her latitude 296 miles, and longitude 7° 17′. Required both latitudes and course?

By Construction.

Plate CCCXXXVII.

With the distance and difference of latitude construct the triangle ABC (fig. 27.) and make CD equal to the difference of longitude 437; then the course BAC will be found to measure 49° 44′, and the middle latitude BCD 36° 54′: Hence the latitude left is 34° 26′, and that come to 39° 22′.

By Calculation.

To find the course.

As the difference of latitude	296	-	2.47129
is to the distance -	458	-	2.66086
so is radius - -			10.00000
to the secant of the course	49° 44′		10.18957

To find the middle latitude.

As the difference of longitude	437	-	2.64048
is to the distance -	458	-	2.66086
so is the sine of the course	49 44	-	9.88255
to the cosine of the middle latitude -	36 54	-	9.90293
Half difference of latitude	2 28		
Latitude left - -	34 26		
Latitude come to -	39 22		

By Inspection.

To half the distance 229 the difference of latitude is 150.2 at 49°, and 147.2 at 50°.

Then, as 3.0 : 2.2 :: 60′ : 44′

Therefore the course is 49° 44′

Also the departure is 172.8 at 49°, and 175.4 at 50°.

Hence, as 3.0 : 2.2 : : 2.6 : 1.9

And 172.8 + 1.9 = 174.7 = half the departure.

Now to half the difference of longitude 218.5 in a distance column, the difference of latitude is 176.8 at 36°, and 174.5 at 37°.

Then, as 2.3 : 2.1 : : 60′ : 54′.

Hence the middle latitude 36° 54′; and therefore the latitude sailed from is 34° 26′, and that come to 39° 22′.

By Gunter's Scale.

Middle Latitude Sailing

The extent from the distance 458 to the difference of latitude 296 on numbers, will reach from 90° to 40° 16′ the complement of the course on fines; and the extent from the difference of longitude 437 to the distance 458 on numbers, will reach from the course 49° 44′, to the complement of the middle latitude 53° 6′ on the line of fines: Hence the latitudes are 34° 26′ and 39° 22′ respectively.

Prob. XII. Given the distance, middle latitude, and difference of longitude, to find both latitudes and course.

Example. The distance is 384 miles between the south and east, the middle latitude 54° 6, and difference of longitude 6° 36′. Required both latitude and course?

By Construction.

Plate CCCXXXVIII.

With the middle latitude 54° 6′, and difference of longitude 396, construct the triangle BCD (fig. 28.) and make AC equal to the given distance 384 miles. Then the course BAC will be found to measure 37° 12′, and the difference of latitude AB 306 miles.—Hence the latitude sailed from is 56° 39′, and that come to 51° 33′.

By Calculation.

To find the course.

As the distance -	384	-	2.58433
is to the difference of longitude -	396	-	2.59769
so is the cosine of middle latitude -	54° 6′	-	9.76817
to the sine of the course	37 12	-	9.78153

To find the difference of latitude.

As radius - -			10.00000
is to the cosine of the course	37° 12′	-	9.90120
so is the distance -	384	-	2.58433
to the difference of latitude	305.9	-	2.48553
Middle latitude -	54° 6′		
Half difference of latitude	2 33		
Latitude sailed from -	56 39 N		
Latitude come to -	51 33 N		

By Inspection.

To the middle latitude 54°, and half the difference of longitude 198 in a distance column, the number in a latitude column is 116.4. Now half the distance 192 and 116.4 in a departure column, are found to agree nearly under the course 37°, and the corresponding difference of latitude 153; which doubled is 306 miles. Hence the latitude left is 56° 39′ N, and latitude come to 51° 33′ N.

By Gunter's Scale.

The extent from the distance 384 to the difference of longitude 396 on the line of numbers, will reach from 35° 54′, the complement of the middle latitude, to 37° 12′, the course on the line of fines: And the extent from 90° to 52° 48′ the complement of the course on fines, will reach from the distance 384 to the difference of latitude 306 on numbers. Hence the latitudes are known.

Prob. XIII. To determine the difference of longitude made good upon compound courses, by middle latitude sailing.

Middle Latitude Sailing.

Rule I. With the ſeveral courſes and diſtances find the difference of latitude and departure made good, and the ſhip's preſent latitude, as in traverſe ſailing.

Now enter the traverſe table with the given middle latitude, and the departure in a latitude column, the correſponding diſtance will be the difference of longitude, of the ſame name with the departure.

Example. A ſhip from Cape Clear, in latitude 51° 18′ N, longitude 9° 46′ W, ſailed as follows:—SW*b*S 34 miles, W*b*N 63 miles, NNW 48 miles, and NE¼E 85 miles. Required the latitude and longitude come to?

Courſes.	Diſt.	Diff. of latitude N	Diff. of latitude S	Departure E	Departure W
SW*b*S	54	—	44·9	—	30.0
W*b*N	63	12.3	—	—	61.8
NNW	48	44·4	—	—	18.4
NE¼E	85	53·9	—	65·7	—
		110.6	44·9	65·7	110.2
		44·9	—	—	65·7
		65.7	—	—	44·5
N 34° W	79	65.7 = 1 6N			

Latitude of Cape Clear 51 18N

Latitude come to - 52 24N
Sum - - 103 42
Middle latitude - 51 51

Now, to middle latitude 51° 51 or 52°, and departure 44.5 in a latitude column, the difference of longitude is 72 in a diſtance column.

Longitude of Cape Clear - 9 46 W
Difference of longitude - 1 12 W

Longitude come to - 10° 58′ W

The above method is that always practiſed to find the difference of longitude made good in the courſe of a day's run; and will, no doubt, give the difference of longitude tolerably exact in any probable run a ſhip may make in that time, eſpecially near the equator. But in a high latitude, when the diſtances are conſiderable, this method is not to be depended on.—To illuſtrate this, let a ſhip be ſuppoſed to ſail from latitude 57° N, as follows: E 240 miles, N 240 miles, W 240 miles, and S 240 miles: then, by the above method, the ſhip will be come to the ſame place ſhe left. It will, however, appear evident from the following conſideration, that this is by no means the caſe; for let two ſhips, from latitude 61° N, and diſtant 240 miles, ſail directly ſouth till they are in latitude 57° N; now their diſtance being computed by Problem IV. of Parallel Sailing, will be 269.6 miles; and, therefore, if the ſhip ſailed as above, ſhe will be 29.6 miles weſt of the place ſailed from; and the error on longitude will be equal to 240 × ſecant 61° — ſecant 57° = 29.6 × ſecant 57°.

Middle Latitude Sailing.

Theorems might be inveſtigated for computing the errors to which the above method is liable. Theſe corrections may, however, be avoided, by uſing the following method.

Rule II. Complete the traverſe table as before, to which annex five columns: the firſt column is to contain the ſeveral latitudes the ſhip is in at the end of each courſe and diſtance; the ſecond, the ſums of each following pair of latitude; the third, half the ſums, or middle latitudes; and the fourth and fifth columns are to contain the differences of longitude.

Now find the difference of longitude anſwering to each middle latitude and its correſponding departure, and put them in the eaſt or weſt difference of longitude columns, according to the name of the departure. Then the difference of the ſums of the eaſt and weſt columns will be the difference of longitude made good, of the ſame name with the greater.

Ex. A ſhip from Halliford in Iceland, in lat. 64° 30′ N, long. 27° 15′ W, ſailed as follows: SSW 46 miles, SW 61 miles, S*b*W 59 miles, SE*b*E 86 miles, S*b*E¼E 76 miles. Required the lat. and long. come to?

Traverse Table.

Courſes.	Diſt.	Diff. of Lat N	Diff. of Lat S	Departure E	Departure W
SSW	46	—	42.5	—	17.6
SW	61	—	43.1	—	43.1
S*b*W	59	—	57·9	—	11.5
S*b*E	86		47.8	71.5	—
SE*b*¼E	76	—	72.7	22.0	—
			264.0	93·5	72.2
				72.2	
By Rule I.				21.3	

Latitude Halliford - - 64° 30′ N
Difference of latitude - 4 24 S
Latitude in - - 60 6 N
Sum - - 124 36
Middle latitude - 62 18

Now, to middle lat. 62 18, and departure 21.3, the difference of long. is 46 E.

Longitude Halliford - 27 15 W
Longitude in - - 16 29

The Error of comm. method, in this Ex. is 12′.

Longitude Table.

Succeſſive Latitudes.	Sums.	Middle Latitude.	Diff. of Longitude E	Diff. of Longitude W
64° 30′	—	—	—	—
63 48	128° 18′	64° 9	—	40.4
63 5	126 53	63 27	—	96.4
62 7	125 12	62 36	—	25.0
61 19	123 26	61 43	150.9	—
60 6	121 25	60 43	45.0	—
			195.9	161.8
			161.8	
Difference of longitude -			34.1	
Longitude Halliford -			27.15 W	
Longitude in - -			26.41 W	

Mercator's Sailing.

Chap. VI. *Of Mercator's Sailing.*

It was obſerved in Middle Latitude Sailing, that the difference of longitude made upon an oblique rhumb could not be exactly determined by uſing the middle latitude. In Mercator's ſailing, the difference of longitude is very eaſily found, and the ſeveral problems of ſailing reſolved with the utmoſt accuracy, by the aſſiſtance of Mercator's chart or equivalent tables.

In Mercator's chart the meridians are ſtraight lines parallel to each other; and the degrees of latitude, which at the equator are equal to thoſe of longitude, encreaſe with the diſtance of the parallel from the equator. The parts of the meridian thus encreaſed are called *meridional parts*. A table of theſe parts was firſt conſtructed by Mr Edward Wright, by the continual addition of the ſecants of each minute of latitude.

For by parallel ſailing,

R : cof. of lat. :: part of equat. : ſimilar part of parallel.

And becauſe the equator and meridian on the globe are equal, therefore,

R : cof. lat. : : part of meridian : ſimilar part of parallel.

Or ſec. lat. : R :: part of merid. : ſimilar part of parallel.

Hence, $\frac{\text{ſecant latitude}}{\text{part of meridian,}} = \frac{R}{\text{part of parallel.}}$

But in Mercator's chart the parallels of latitude are equal, and radius is a conſtant quantity. If therefore the latitude be aſſumed ſucceſſively equal to $1'$, $2'$, $3'$, &c. and the correſponding parts of the enlarged meridian be repreſented by a, b, c, &c.; then,

$\frac{\text{ſecant } 1'}{\text{part of mer. } a} = \frac{\text{ſecant } 2'}{\text{part of mer. } b} = \frac{\text{ſecant } 3'}{\text{part of mer. } c.}$ &c

Hence ſecant $1'$: part of mer. a : : ſecant $2'$: part of mer. b : : ſecant $3'$: part of mer. c, &c.

Therefore by 12th V. Euclid,

Secant $1'$: part of mer. a : : ſecant $1' +$ ſecant $2' +$ ſecant $3'$, &c. : parts of mer. $a+b+c$, &c.

That is, the meridional parts of any given latitude is equal to the ſum of the ſecants of the minutes in that latitude (D).

Since CD : LK :: R : ſecant LD, fig. 15.

And in the triangle CED,

ED : CD : : R : tangent CED;

Therefore, ED : LK :: R^2 : ſecant LD × tangent CED

Hence $LK = \frac{ED \times \text{ſec } LD \times \text{tang. } CED}{R^2} = \frac{ED \times \text{ſec. } LD}{R} \times \frac{\text{tang. } CED}{R}$.

But $\frac{ED \times \text{ſec. } LD}{R}$ is the enlarged portion of the meridian anſwering to ED. Now the ſum of all the quantities $\frac{ED \times \text{ſecant } LD}{R}$ correſponding to the ſum of all the ED's contained in AS will be the meridional parts anſwering to the difference of latitude AS; and MN is the ſum of all the correſponding portions of the equator LK.

Whence MN = mer. diff. of lat. × tangent $\frac{CED}{R.}$

That is, the difference of longitude is equal to the meridional difference of latitude multiplied by the tangent of the courſe, and divided by the radius. Mercator's Sailing.

This equation anſwers to a right-angled rectilineal triangle, having an angle equal to the courſe; the adjacent ſide equal to the meridional difference of latitude, and the oppoſite ſide the difference of longitude. This triangle is therefore ſimilar to a triangle conſtructed, with the courſe and difference of latitude, according to the principles of plane ſailing, and the homologous ſides will be proportional. Hence if, in fig. 29. the angle A repreſents the courſe AB the difference of latitude, and if AD be made equal to the meridional difference of latitude; then DE, drawn perpendicular to AD, meeting the diſtance produced to E, will be the difference of longitude. Plate CCCXXXVIII.

It is ſcarce neceſſary to obſerve, that the meridional difference of latitude is found by the ſame rules as the proper difference of latitude; that is, if the given latitudes be of the ſame name, the difference of the correſponding meridional parts will be the meridional difference of latitude; but if the latitudes are of a contrary denomination, the ſum of theſe parts will be the meridional difference of latitude.

Prob. I. Given the latitudes and longitudes of two places, to find the courſe and diſtance between them.

Example. Required the courſe and diſtance between Cape Finiſterre, in latitude 42° 52′ N, longitude 9° 17′ W, and Port Praya in the iſland of St Jago, in latitude 14° 54′ N, and longitude 23° 29′ W?

Lat. Cape Finiſterre	42° 52′	Mer. parts	2852
Latitude Port Praya	14 54	Mer. parts	904.
Difference of lat. =	27 58	Mer. diff. lat.	1948

1678

Longitude Cape Finiſterre -	9° 17′ W
Longitude Port Praya -	23 29 W
Diff. longitude -	14 12 = 852.

By Conſtruction.

Draw the ſtraight line AD (fig. 29.) to repreſent the meridian of Cape Finiſterre, upon which lay off AB, AD equal to 1678 and 1948, the proper and meridional differences of latitude; from D draw DE perpendicular to AD, and equal to the difference of longitude 852 join AE, and draw BC parallel to DE; then the diſtance AC will meaſure 1831 miles, and the courſe BAC 23° 37′.

By Calculation.

To find the courſe.

As the meridian difference of lat.	1948	3.28959
is to the difference of longitude	852	2.93044
ſo is radius - - -		10.00000
to the tangent of the courſe	23° 37	9.64085

To find the diſtance.

As radius - - -		10.00000
is to the ſecant of the courſe,	23° 37′	10.03798
ſo is the difference of latitude	1678	3.22479
to the diſtance -	1831	3.26277

(D) This is not ſtrictly true; for inſtead of taking the ſum of the ſecants of every minute in the diſtance of the given parallel from the equator, the ſum of the ſecants of every point of latitude ſhould be taken.

Mercator's Sailing.

By Inſpection.

As the meridian difference of latitude and difference of longitude are too large to be found in the tables, let the tenth of each be taken; theſe are 194.8 and 85.2 reſpectively. Now theſe are found to agree neareſt under 24°; and to 167.8, one-tenth of the proper difference of latitude, the diſtance is about 183 miles, which multiplied by 10 is 1830 miles.

By Gunter's Scale.

The extent 1948, the meridional difference of latitude, to 852, the difference of longitude on the line of numbers, will reach from 45° to 23° 37′, the courſe on the line of tangents. And the extent from 66° 23′, the complement of the courſe to 90° on ſines, will reach from 1678, the proper difference of latitude, to 1831, the diſtance on the line of numbers.

Prob. II. Given the courſe and diſtance ſailed from a place whoſe ſituation is known, to find the latitude and longitude of the place come to.

Example. A ſhip from Cape Hinlopen in Virginia, in latitude 38° 47′ N, longitude 75° 4′ W, ſailed 267 miles NE*b*N. Required the ſhip's preſent place?

By Conſtruction.

Plate CCCXXXVIII. With the courſe and diſtance ſailed conſtruct the triangle ABC (fig. 30.); and the difference of latitude AB being meaſured, is 222 miles: hence the latitude come to is 42° 29′ N, and the meridional difference of latitude 293. Make AD equal to 293; and draw DE perpendicular to AD, and meeting AC produced in E: then the difference of longitude DE being applied to the ſcale of equal parts will meaſure 196; the longitude come to is therefore 71° 48′ W.

By Calculation.

To find the difference of latitude.

As radius - -		10.00000
is to the coſine of the courſe,	3 points	9.91985
ſo is the diſtance -	267	2.42651
to the difference of latitude	222	2.34636

Lat. Cape Hinlopen = 38° 47′ N. Mer. parts 2528
Difference of lat. 3 42 N.

Latitude come to 42 29 N. Mer. parts 2821

Meridional difference of lat. 293

To find the difference of longitude.

As radius - -		10.00000
is to the tangent of the courſe,	3 points	9.82489
ſo is the mer. diff. of latitude	293	2.46687
to the difference of longitude	195.8	2.29176

Longitude Cape Hinlopen 75° 4′ W
Difference of longitude - 3 16 E

Longitude come to - 71 48 W

By Inſpection.

To the courſe 3 points, and diſtance 267 miles, the difference of latitude is 222 miles: hence the latitude in, is 42° 29′, and the meridional difference of latitude 293. Again, to courſe 3 points, and 146.5 half the mer. difference of latitude, the departure is 97.9, which doubled is 195.8, the difference of longitude.

By Gunter's Scale.

The extent from 8 points to the complement of the courſe 5 points on fine rhumbs, will reach from the diſtance 267 to the difference of latitude 222 on numbers; and the extent from 4 points to 3 points on tangent rhumbs, will reach from the meridional difference of latitude 293 to the difference of longitude 196 on numbers.

Mercator's Sailing.

Prob. III. Given the latitudes and bearing of two places, to find their diſtance and difference of longitude.

Example. A ſhip from Port Canſo in Nova Scotia, in latitude 45° 20′ N, longitude 60° 55′ W, ſailed SE ½ S, by obſervation is found to be in latitude 41° 14′ N. Required the diſtance ſailed, and longitude come to?

Lat. Port Canſo -	45° 20′ N	Mer. parts -	3058
Lat. in by obſervation	41 14 N	Mer. parts -	2720
Difference of lat. -	4 6	Mer. diff. lat.	338

246

By Conſtruction.

Make AB (fig. 31.) equal to 246, and AD equal to 338; draw AE, making an angle with AD equal to 3¼ points, and draw BC, DE perpendicular to AD. Now AC being applied to the ſcale, will meaſure 332, and DE 306.

By Calculation.

To find the diſtance.

As radius - -		10.00000
is to the ſecant of the courſe,	3¼ points	10.13021
ſo is the difference of latitude	246	2.39093
to the diſtance -	332	2.52114

To find the difference of longitude.

As radius - -		10.00000
is to the tangent of the courſe,	3¼ points	9.95729
ſo is the mer. diff. of latitude	338	2.52892
to the difference of longitude	306.3	2.48621

Longitude Port Canſo - 60° 55′ W
Difference of longitude - 5 6 E

Longitude in - - 55 49 W

By Inſpection.

Under the courſe 3¼ points, and oppoſite to half the difference of latitude, 123 in a latitude column is 166 in a diſtance column, which doubled is 332 the diſtance; and oppoſite to 169, half the meridional difference of latitude in a latitude column, is 153 in a departure column, which doubled is 306, the difference of longitude.

By Gunter's Scale.

The extent from the complement of the courſe 4¼ points to 8 points on fine rhumbs, will reach from the difference of latitude 246 m. to the diſtance 332 on numbers; and the extent from 4 points, to the courſe 3¼ points on tangent rhumbs, will reach from the meridional difference of latitude 338 to the difference of longitude 306 on numbers.

Prob. IV. Given the latitude and longitude of the place ſailed from, the courſe, and departure; to find the diſtance, and the latitude and longitude of the place come to.

Example. A ſhip ſailed from Sallee in latitude 33° 58′ N, longitude 6° 20′ W, the corrected courſe was NW*b*W ½ W, and departure 420 miles. Required

Mercator's Sailing.

the distance run, and the latitude and longitude come to?

By Construction.

Plate CCCXXVIII

With the course and departure construct the triangle ABC (fig. 32); now AC and AB being measured, will be found equal to 476 and 224 respectively: hence the latitude come to is 37° 42′ N, and meridional difference of latitude 276. Make AD equal to 276; and draw DE perpendicular thereto, meeting the distance produced in E; then DE applied to the scale will be found to measure 516. The longitude in therefore is 14° 56′ W.

By Calculation.

To find the distance.

As radius - - -		10.00000
is to the cosecant of the course,	5½ pts	10.05457
so is the departure - -	420	2.62325
to the distance - - -	476.3	2.67782

To find the difference of latitude.

As radius - - -		10.00000
is to the co-tangent of the course,	5½ pts	9 72796
so is the departure -	420	2.62325
to the difference of latitude -	224.5	2 35121

Lat. of Sallee 33° 58′ N Mer. parts 2169
Diff. of lat. 3 44 N
Latitude in 37 42 N Mer. parts 2445
Mer. difference of latitude 276

To find the difference of longitude.

As radius - - -		10.00000
is to the tangent of the course	5½ pts	10.27204
so is the mer. diff. of latitude	276	2.44091
to the difference of longitude	516.3	2.71295

Longitude of Sallee - 6° 20′ W
Difference of longitude - 8 36 W
Longitude in - - 14 56 W

By Inspection.

Above 5½ points the course, and opposite to 210 half the departure, are 238 and 112; which doubled, we have 476 and 224, the distance and difference of latitude respectively. And to the same course, and opposite to 138, half the meridional difference of latitude, in a latitude column, is 258 in a departure column; which being doubled is 516, the difference of longitude.

By Gunter's Scale.

The extent from 5½ points, the course on fine rhumbs, to the departure 420 on numbers, will reach from 8 points on fine rhumbs to the distance 476 on numbers; and from the complement of the course 2½ points on fine rhumbs to the difference of latitude 224 on numbers.

Again, the extent from difference of latitude 224 to the meridional difference of latitude 276 on numbers, will reach from the departure 420 to the difference of longitude 516 on the same line.

Prob. V. Given the latitudes of two places, and their distance, to find the course and difference of longitude.

Example. A ship from St Mary's, in latitude 36° 57′ N, longitude 25° 9′ W, sailed on a direct course between the north and east 1162 miles, and is then by observation in latitude 49° 57′ N. Required the course and longitude come to?

Mercator's Sailing.

Lat. of St Mary's - 36° 57′ N Mer. parts - 3470
Lat. come to - 49 57 N Mer. parts 2389
Difference of lat. 13 0 Mer. diff. lat. 1081
780

By Construction.

Make AB (fig. 33.) equal to 780, and AD equal to 1081; draw BC, DE perpendicular to AD; make AC equal to 1162 m. and through AC draw ACE. Then the course or angle A being measured, will be found equal to 47° 50′, and the difference of longitude DE will be 1194.

By Calculation.

To find the course.

As the distance - -	1162	3.06521
is to the difference of latitude,	780	2.89209
so is radius - - -		10.00000
to the cosine of the course -	47° 50′	9.82688

To find the difference of longitude.

As radius - -		10.00000
is to the tangent of the course,	47° 50′	10.04302
so is the mer. diff. of latitude	1081	3.03383
to the difference of longitude	1194	3.07685

Longitude of St Mary's - 25° 9′ W
Difference of longitude - 19 54 E
Longitude in - 5 15 W

By Inspection.

Because the distance and difference of latitude exceed the limits of the table, take the tenth of each; these are 116.2 and 78.0: Now these are found to agree nearest above 4½ points, which is therefore the course; and to this course, and opposite to 108.1, one tenth of the meridional difference of latitude, in a latitude column, is 119.3 in a departure column, which multiplied by 10 is 1193, the difference of longitude.

By Gunter's Scale.

The extent from the distance 1162 m. to the difference of latitude 780 m. on numbers, will reach from 90° to 42° 10′ in the line of fines. And the extent 45°, to the course 47° 50′ on the line of tangents, will reach from the meridional difference of latitude 1081 to the difference of longitude 1194 on numbers.

Prob. VI. Given the latitudes of two places, and the departure; to find the course, distance, and difference of longitude.

Example. From Aberdeen, in latitude 57° 9′ N, longitude 2° 9′ W. a ship sailed between the south and east till her departure is 146 miles, and latitude come to 53° 32′ N. Required the course and distance run, and longitude come to?

Latitude Aberdeen 57° 9 N. mer. parts 4199
Latitude come to 53 32 N. mer. parts 3817
Difference of latitude 3 37 mer. diff. of lat. 382
217.

By

Mercator's Sailing.

Plate ccccxxxviii

By Conſtruction.

With the difference of latitude 217m. and departure 146m. conſtruct the triangle ABC (fig. 34.), make AD equal to 382, draw DE parallel to BC, and produce AC to E: Then the courſe BAC will meaſure 33° 56′, the diſtance AC 261, and the difference of longitude DE 257.

By Calculation.

To find the courſe.

As the difference of latitude	217	2.33646
is to the departure	146	2.16435
ſo is radius - - -		10.00000
to the tangent of the courſe	33° 56′	9.82789

To find the diſtance.

As radius - - -		10.00000
is to the ſecant of the courſe	33° 56′	10.08109
ſo is the difference of latitude	217	2.33646
to the diſtance	261.5	2.41755

To find the difference of longitude.

As the difference of latitude	217	2.33646
is to the mer. diff. of latitude	382	2.58206
ſo is the departure	146	2.16435
to the difference of longitude	257	2.40995
Longitude of Aberdeen		2° 9′ W
Difference of longitude		4 17 E
Longitude come to - -		2 8 E

By Inſpection.

The difference of latitude 217, and departure 146, are found to agree neareſt under 34°, and the correſponding diſtance is 262 miles. To the ſame courſe, and oppoſite to 190.7, the neareſt to 191 half the meridional difference of latitude, is 128.6 in a departure column, which doubled is 257, the difference of longitude.

By Gunter's Scale.

The extent from the difference of latitude 217, to the departure 146 on numbers, will reach from 45° to about 34°, the courſe on the line of tangents; and the ſame extent will reach from the meridional difference of latitude 382 to 257, the difference of longitude on numbers.—Again, the extent from the courſe 34° to 90 on ſines, will reach from the departure 146 to the diſtance 261 on numbers.

Prob. VII. Given one latitude, diſtance, and departure; to find the other latitude, courſe, and difference of longitude.

Example. A ſhip from Naples, in latitude 40° 51′ N, longitude 14° 14′ E, ſailed 252 miles on a direct courſe between the ſouth and weſt, and made 173 miles of weſting. Required the courſe made good, and the latitude and longitude come to?

By Conſtruction.

With the diſtance and departure make the triangle ABC (fig. 35.) as formerly.—Now the courſe BAC being meaſured by means of a line of chords will be found equal to 43° 21′, and the difference of latitude applied to the ſcale of equal parts will meaſure 183′: hence the latitude come to is 37° 48′ N, and meridional difference of latitude 237.—Make AD equal to 237, and complete the figure, and the difference of longitude will meaſure 224′: hence the longitude in is 10° 30′ E.

By Calculation.

Mercator's Sailing.

To find the courſe

As the diſtance	252	2.40140
is to the departure	173	2.23805
ſo is radius - - -		10.00000
to the ſine of the courſe	43° 21′	9.83665

To find the difference of latitude.

As radius		10.00000
is to the coſine of the courſe	43° 21′	9.86164
ſo is the diſtance	252	2.40140
to the difference of latitude	183.2	2.26304
Latitude of Naples	40° 51′ N.	Mer. parts 2690
Difference of latitude	3 3 S	
Latitude come to	37 48 N.	Mer. parts 2453
Meridional difference of latitude		237

To find the difference of longitude.

As radius		10.00000
is to the tangent of the courſe	43° 21′	9.97497
ſo is the mer. diff. of latitude	237	2.37475
to the difference of longitude	223.7	2.34972
Longitude of Naples		14° 14′ E
Difference of longitude		3 44 W
Longitude in - -		10 30 E.

By Inſpection.

Under 43° and oppoſite to the diſtance 252 m. the departure is 171.8, and under 44°, and oppoſite to the ſame diſtance, the departure is 175.0.

Then as 3.2 : 1.2 :: 60′ : 22′

Hence the courſe is 43° 22′

Again, under 43° and oppoſite to 118.5, half the meridional difference of latitude in a latitude column, is 110.5 in a departure column; alſo under 44° and oppoſite to 118.5 is 114.4.

Then as 3.2 : 1.2 :: 3.9 : 1.5

And 110.5+1.5 = 112, which doubled is 224, the difference of longitude.

By Gunter's Scale.

The extent from the diſtance 252 on numbers to 90° on ſines will reach from the departure 173 on numbers to the courſe 43°$\frac{1}{3}$ on ſines; and the ſame extent that will reach from the complement of the courſe 46°$\frac{2}{3}$ on ſines will reach to the difference of latitude on numbers.—Again, the extent from 45° to 43°$\frac{1}{3}$ on tangents will reach from the meridional difference of latitude 237 to the difference of longitude 224 on numbers.

Prob. VIII. Given one latitude, courſe and difference of longitude; to find the other latitude and diſtance.

Example. A ſhip from Tercera, in latitude 38° 45′ N, longitude 27° 6′ W, ſailed on a direct courſe, which, when corrected, was N 32° E, and is found by obſervation to be in longitude 18° 24′ W. Required the latitude come to, and diſtance ſailed?

Longitude of Tercera		27° 6′ W.
Longitude in		18 24 W
Difference of longitude -		8 42 = 522

Mercator's Sailing.

Plate ccexxxviii

By Conſtruction.

Make the right angled triangle ADE (fig. 36.) having the angle A equal to the courſe 32°, and the ſide DE equal to the difference of longitude 522: then AD will meaſure 835, which added to the meridional parts of the latitude left, will give theſe of the latitude come to 48° 46′; hence the difference of latitude is 601: make AB equal thereto, to which let BC be drawn perpendicular; then AC applied to the ſcale will meaſure 708 miles.

By Calculation.

To find the meridional difference of latitude.

As radius		10.00000
is to the co-tangent of the courſe	32° 0′	10.20421
ſo is the difference of longitude	5 22	2.71767
to the mer. difference of latitude	8352	2.92188
Latitude of Tercera 38° 45′ N	Mer. parts	2526
	Mer. diff. of lat.	835
Latitude come to 48 46 N.	Mer. parts	3361

Difference of latitude 10 1 = 601 miles.

To find the diſtance.

As radius		10.00000
is to the ſecant of the courſe	32° 0′	10.07158
ſo is the difference of latitude	601	2.77887
to the diſtance	707.7	2.85045

By Inſpection.

To courſe 32°, and oppoſite to 130.5, one fourth of the given difference of latitude in a departure column, the difference of latitude is 208.8, which multiplied by 4 is 835, the meridional difference of latitude; hence the latitude in is 48° 46′ N, and difference of latitude 601.

Again, to the ſame courſe, and oppoſite to 200, one third of the difference of latitude, the diſtance is 236, which multiplied by 3 gives 708 miles.

By Gunter's Scale.

The extent from the courſe 32° to 45° on tangents will reach from the difference of longitude 522 to the meridional difference of latitude 835 on numbers.—And the extent from the complement of the courſe 58° to 90° on ſines, will reach from the difference of latitude 601 to the diſtance 708 miles on numbers.

Prob IX. To find the difference of longitude made good upon compound courſes.

Rule. With the ſeveral courſes and diſtances, complete the Traverſe Table, and find the difference of latitude, departure, and courſe made good, and the latitude come to as in Traverſe Sailing. Find alſo the meridional difference of latitude.

Now, to the courſe and meridional difference of latitude in a latitude column, the correſponding departure will be the difference of longitude, which applied to the longitude left will give the ſhip's preſent longitude.

Example. A ſhip from Port St Julian, in latitude 49° 1c′ S, longitude 68° 44′ W, ſailed as follows, ESE 53 miles, SE*b*S 74 miles, E by N 68 m. SE*b*E½E 47 miles, and E 84 miles. Required the ſhip's preſent place?

Mercator's Sailing.

Courſes.	Diſt.	Diff. of Lat. N	Diff. of Lat. S	Departure E	Departure W
ESE	53		20.3	49.0	
SE*by*S	74		61.5	41.1	
E*by*N	68	13.3		66.7	
SE*by*E½E	47		22.1	41.5	
E	84			84 0	
		13.3	103.9	282.3	
			13.3		
S 72° E	297		90.6 = 1° 31′		
Latitude left,			49 10 S m.pt. 3397		
Latitude come to			50 41 S m.pt. 3539		
Mer. difference of latitude					142

Now to courſe 72°, and oppoſite to 71, half the mer. difference of latitude in a latitude column, is 218.7 in a departure column, which doubled is 437, the difference of longitude.

Longitude of Port St Julian	68° 44′ W
Difference of longitude	7 17 E
Longitude come to	61 27 W

Although the above method is that uſually employed at ſea to find the difference of longitude, yet as it has been already obſerved, it is not to be depended on, eſpecially in high latitudes; in which caſe the following method becomes neceſſary.

Rule II. Complete the Traverſe Table as before, to which annex five columns. Now with the latitude left, and the ſeveral differences of latitude, find the ſucceſſive latitudes, which are to be placed in the firſt of the annexed columns; in the ſecond the meridional parts correſponding to each latitude is to be put; and in the third, the meridional differences of latitude.

Then to each courſe, and correſponding meridional difference of latitude, find the difference of longitude, which place in the fourth or fifth columns, according as the courſe is eaſterly or weſterly; and the difference between the ſums of theſe columns will be the difference of longitude made good upon the whole of the ſame name with the greater.

Remarks.

1. When the courſe is north or ſouth, there is no difference of longitude.

2. When the courſe is eaſt or weſt, the difference of longitude cannot be found by Mercator's Sailing; in this caſe the following rule is to be uſed.

To the neareſt degree to the given latitude taken as a courſe, find the diſtance anſwering to the departure in a latitude column: this diſtance will be the difference of longitude.

Example I. Four days ago we took our departure from Faro-head, in latitude 58° 40′ N. and longitude 4° 50′ W, and ſince have ſailed as follows: NW 32 miles, W 69 miles, WNW 93 miles, W*b*S 77 miles, SW 58 miles, and W½S 49 miles—Required our preſent latitude and longitude?

Tra-

Mercator's Sailing.

Mercator's Sailing.

Traverse Table.						Longitude Table.				
Courses.	Dist.	Diff. of Lat. N	Diff. of Lat. S	Departure. E	Departure. W	Succeslive Latitudes.	Merid. Parts.	Merid. Diff. Lat.	Diff of Longitude. E	Diff of Longitude. W
						58° 40′	4370			
NW	32	22.6			22.6	59 3	4415	45		45.0
W	69				69.0	59 3	4415	0		134.0
WNW	93	35.6			85.9	59 38	4484	69		166.5
W b S	77		15.0		75.5	59 23	4454	30		151.0
SW	58		41.0		41.0	58 42	4374	80		80.0
W ¼ S	49		7.2		48.5	58 35	4361	13		88.0
		58.2	63.2		342.5					664.5
			58.2			Longitude of Faro-head -				4° 50′ W.
						Difference of longitude -				11 4 W.
W 1° S	343		5.0			Longitude in -				15 54 W.

EXAMPLE II. A ship from latitude 78° 15′ N, longitude 28° 14′ E. sailed the following courses and distances. The latitude come to is requred, and the longitude, by both methods: the bearing and distance of Hacluit's head-land, in latitude 79° 55′ N. longitude 11° 55 E. is also required?

Traverse Table.						Longitude Table.				
Courses.	Dist.	Diff. of Latitude N	Diff. of Latitude S	Departure. E	Departure. W	Successive Latitudes.	Merid. Parts.	Merid. Diff. Lat.	Diff. of Longitude. E	Diff. of Longitude. W
						78° 15′	7817		—	
WNW	154	58.9	—	—	142.3	79 14	8120	303	—	731.7
SW	96	—	67.9	—	67.9	78 6	7774	346	—	346.0
NW ½ W	89	56.4	—	—	68.8	79 2	8056	282	—	343.6
N b E	110	107.9	—	21.5	—	80 50	8676	620	123.6	—
NW ¼ N	56	45.0	—	—	33.4	81 35	8970	294	—	218.0
S b E ¼ E	78	—	73.4	26.3	—	80 22	8504	466	166.7	—
		268.2	141.3	47.8	312.4				290.3	1639.3
		141.3			47.8					290.3
		126.9			264.6					1349.0

By Rule 1st.

Latitude left 78° 15′ N. Mer. pts = 7817
Diff. of latitude 2 7 N.

Lat. come to 80 22 N. Mer. pts = 8504

Meridional diff. of latitude - 687
As difference of lat. 126.9 2.10346
is to mer. diff. of latit. 687 - 2.83696
so is the departure 264.6 - 2.42256

to difference of longit. 1432 - 3.15606

23° 52′ W.
Longitude left 28 14 E.

Longitude in 4 22 E.

The error of this method, in the present example, is therefore 1° 23′.

Longitude left - - 28° 14′ E.
Difference of longitude - 22 29 W.

Longitude in - - 5 45 E.

To find the bearing and distance of Hacluit's head-land.

Lat. H H. = 79° 55′ N. M.P. 8347 Lon. 11° 55′ E.
Lat. ship. = 80 22 N. M.P. 8504 Lon. 5 45 E.

Diff. lat. 0 27 M.D.L. 157 D.L. 6 10

370

Now to 78.5 half the meridional difference of latitude, and 185.0 half the difference of longitude, the course 67°, and opposite to the difference of latitude 27, the distance is 69 miles.—Hence Hacluit's head-land bears S 67° E. distant 69 miles.

Method of resolving the Problems of Mercator's Sailing.

CHAP. VII. *Containing the Method of resolving the several Problems of Mercator's Sailing, by the Assistance of a Table of Logarithmic Tangents.*

PROB. The constant quantity 12.633114 (G) is to the difference or sum of the logarithmic tangents of half the co-latitudes of two places, according as these latitudes are of the same, or a contrary denomination; as the tangent of the course is to the difference of longitude.

Demonst. Let CABP, Plate CCCXXXVIII. fig 37. be a section of one fourth of the earth in the plane of the meridian; and let AC be the radius of the equator, and B any given place whose latitude is therefore AB. Draw BD perpendicular to AC, and BE parallel to it; and let B*b* be a very small portion of the meridian, as one minute.——Now put CA = r, DB = y, BE = x, and z = meridional parts answering to the arch AB.

Method of resolving the Problems of Mercator's Sailing.

Then, $x : r :: bn : \frac{r}{x} \times bn$

but, $x : r :: \frac{r}{x} \times bn : \frac{r^2}{x^2} \times bn$ = correspondent portion of the enlarged meridian. Now these being put into fluxions, we have,

$$\dot{z} = \frac{r^2}{x^2} \times \dot{y} = \frac{\dot{y}}{r^2 - y^2}$$

Of which the fluent is,

$$z = \frac{2.302585 \times r}{2} \times \log. \frac{r+y}{r-y}$$

$$= 2.302585 \times r \times \log. \sqrt{\frac{r+y}{r-y}}$$

Now as the meridional parts are expressed in parts of the equator, this equation becomes,

$$z = \frac{2.302585 \times 180^{\circ} \times 60'}{3.15149} \times \log. \sqrt{\frac{r+y}{r-y}} = \frac{1}{.0001263314} \times \log. \sqrt{\frac{r+y}{r-y}},$$

But $\log. \sqrt{\frac{r+y}{r-y}} = \log. \sqrt{\frac{r + \text{fine } AB)}{r - \text{fine } AB)}} = \log. \sqrt{\frac{\tan. (45 + \frac{1}{2}AB)}{\tan. (45 - \frac{1}{2}AB)}}$

And the tang. $(45 - \frac{1}{2}AB) = \frac{1}{\tan. (45 + \frac{1}{2}AB)}$

Therefore $z = \frac{1}{.00012633114} \times \log. \sqrt{\tan. (45 + \frac{1}{2}AB)^2} =$

$$= \frac{\text{log. tang. } (45 + \frac{1}{2}AB)}{.00012633114.} = \frac{\text{log. tang. half co-latitude.}}{.00012633114, \&c.}$$

Hence the meridional parts answering to any given latitude, is found by dividing the difference between the log. of the radius and the log. tangent of half the complement of latitude, by the constant quantity .00012633114, &c.; and the meridional difference of latitude is obtained by dividing the difference or sum of the logarithmic tangents of half the co-latitudes, according as they are of the same or a contrary name, by the above quantity.

And the meridional difference of latitude multiplied by the tangent of the course, is equal to the difference of longitude. Hence the proposition is manifest.

This method shall be illustrated with examples performed by calculation: the other methods of solution are purposely omitted.

PROB. I. Given the latitudes and longitudes of two places, to find the course and distance between them.

EXAMPLE. Required the bearing and distance of Ostend, in lat. 51° 14′ N.; long. 2°56 E from Aberdeen, in latitude 57° 9 N. and longitude 2° 9′ W.?

Long. Aberdeen,	2°	9 W.	Lat. 57° 9′	comp. 32° 51′	half 16°	25½	tangent	9 46951		
Long. Ostend,	2	56 E.	Lat. 51 14	comp. 38 46	half 19	23	tangent	9.54633		
Diff. longitude	5	5=305	Diff. Lat. 5	55=355					Difference	7682

To find the course.

As the difference of the log. tang. 7682		3.88547
is to the constant logarithm -		11.10151
so is the diff. of longitude	305	2.48430
to the tangent of the course	26° 38′	9.70034

To find the distance.

As radius - - -		10.00000
is to the secant of the course	26° 38′	10.04871
so is the difference of latitude	355	2.55023
to the distance -	397.1	2.59894

PROB. II. Given the latitudes and bearing of two places; to find the distance and differ. of longitude.

EXAMPLE. Two days ago we were in latitude 23° 18′S. longitude 16° 54′W.; and having run upon a direct course, which corrected was S. 53°E. we were found to be in latitude 26° 26′S. Required the distance sailed, and longitude come to?

Lat. left,	23° 18′	comp. 66° 42′	half 33° 21′	tang.	9 81831			
Lat. come to,	26 26	comp. 63 34	half 31 47	tang.	9.79213			
Diff. of Lat.	3 8=188m.					Difference	2618	

(G) In this case the tangent is to consist of five figures besides the index; but if the table extends to 6 or 7 figures, the above number will be 126.33, &c. or 1263.3, &c.

Method of resolving the Problems of Mercator's Sailing.

To find the distance.

As radius - - -		10.00000
is to the secant of the course	53°	10.22054
so is the difference of latitude	188	2.27416
to the distance	312.4	2.49470

To find the difference of longitude.

As the constant logarithm -		11.10151
is to the tangent of the course	53°	10.12289
so is the diff. of log. tangents	2618	3.41797
to the difference of longitude	275	2 43935
Longitude left, - -		16° 54 W.
Difference of longitude, -		4 35 E.
Longitude in - -		12 19 W.

Prob. III. Given the latitudes of two places, and the distance between them; to find the course and difference of longitude.

Example. A ship from latitude 48° 10′ N. longitude 15° 12′ W. sailed on a direct course between the south and west 284 miles, and is then in latitude 44° 52′ N. Required the course and longitude come to?

Lat. left, 48° 10′ N. comp. 41° 50′ half 20° 55′ tang. 9.58229
Lat in, 44 52 N. comp. 45 8 half 22 34 tang. 9.61865

Diff. of lat. 3 18 = 198m. Difference 3636

To find the course.

As the distance -	284	2.45332
is to the difference of latitude	198	2.29666
so is radius - - -		10.00000
to the cosine of the course	45° 48′	9 84334

To find the difference of longitude.

As the constant logarithm -		11.10151
is to the tangent of the course	45° 48′	10.01213
so is the diff. of logarithm tangents	3636	3.36062
to the difference of longitude	186.7	2.27124
Longitude left, - -		15° 12 W.
Difference of longitude - -		3 7 W.
Longitude come to - -		18 19 W.

Prob. IV. Given both latitudes and departure, to find the course, distance, and difference of longitude.

Example. A ship from latitude 18° 24′ S, longitude 3° 25′ E sailed between the north and west upon a direct course, till by observation she is in latitude 12° 42′ N. and has made 970 miles of departure.—Required the course, distance, and longitude come to?

Lat. left, 18° 24′ S. comp. 71° 36′ half 35° 48′ cotan. 0.14193
Lat. come to, 12 42 N. comp. 77 18 half 38 39 cotan. 0.09706

Diff. of lat. 31 6 = 1866 Sum 0.23899

To find the course.

As the difference of latitude	1866	3.27091
is to the departure -	970	2.98677
so is radius - - -		10.00000
to the tangent of the course,	27° 28′	9.71586

To find the distance.

As radius - -		10.00000
is to the secant of the course	27° 28′	10.05194
so is the difference of latitude	1866	3.27091
to the distance -	2103	3.32285

To find the difference of longitude.

As the constant logarithm -		11.10151
is to the tangent of the course	27° 28′	9.71586
so is the sum of the log. tangents	23899	4.37838
to the difference of longitude	983.4	2.99273
Longitude left - -		3° 25′ E.
Difference of longitude -		16 23 W.
Longitude come to -		12 58 W.

Method of resolving the Problems of Mercator's Sailing.

Prob. V. Given one latitude course and distance; to find the other latitude and difference of longitude.

Example. From Scarborough, in latitude 54° 20′ N. longitude 0° 10′ W. a ship sailed NE¼E 210 miles. Required the latitude and longitude come to?

To find the difference of latitude.

As radius - - -		10.00000
is to the cosine of the course	4¼ points	9.77503
so is the distance -	210	2.32222
to the difference of latitude	125	2.09725

Lat. left, 54° 20′ N. comp. 35° 40′ half 17° 50′ tang. 9.50746
Diff. of lat. 2 5 N.

Lat. in, 56 25 N. comp. 33 35 half. 16 47½ tang. 9.47964

Difference 2782

To find the difference of longitude.

As the constant logarithm -		11.10151
is to the tangent of the course	4¼ pts.	10.12980
so is the difference of log. tang.	2782	3.44436
to the difference of longitude	296.9	2.47265
Longitude of Scarborough -		0 10 W.
Difference of longitude -		4 57 E.
Longitude come to, - -		4 47 E.

Prob. VI. Given one latitude, course, and departure, to find the other latitude, distance, and difference of longitude.

Example. A ship from latitude 32° 58′ N. longitude 16° 28′ W. sailed SE½S, and made 164 miles of departure. Required the distance run, and latitude and longitude come to?

To find the distance.

As the fine of the course	3½ pts.	9.8 236
is to radius - -		10.00000
so is the departure -	164	2 21484
to the distance -	258.5	2.41248

To find the difference of latitude.

As the tangent of the course	3½ pts.	9.91417
is to radius -	-	10.00000
so is the departure	164	2.21484
to the difference of latitude	199.8	2.30067

Lat. left, - 32° 58′ N. comp. 57° 2′ half 28° 31′ tang. 9.73507
Diff. of lat. 3 20 S.

Lat. come to, 29 38 N. comp. 60 22 half 30 11 tang. 9.76464

Difference 2957

To find the difference of longitude.

As the constant logarithm -		11.10151
is to the tangent of the course	3½ pts.	9.91417
so is the difference of log. tangents	2957	3 47085
to the difference of longitude	192.1	2.28351

Longitude

Method of resolving the Problems of Mercator's Sailing.

Longitude left, - - 16° 28 W.
Difference of longitude, - - 3 12 E.

Longitude in, - - 13 16 W.

PROB. VII. Given one latitude, distance, and departure; to find the other latitude, course, and difference of longitude.

EXAMPLE. A ship from Cape Voltas, in latitude 28° 55′S. longitude 15° 53′E. sailed 286 miles between the south and west, and made 238 miles of departure. Required the course, the latitude and longitude come to?

To find the course.

As the distance -		286	2.45637
is to the departure -		238	2.37658
so is radius - -			10.00000
to the sine of the course	56° 19′		9.92021

To find the difference of latitude.

As radius - -		-	10.00000
is to the cosine of the course	56° 19′		9.74398
so is the distance -		286	2.45637
to the difference of latitude		158.6	2.20035

Lat. Cape Voltas, 28° 55′ S. comp. 61° 5′ half 30° 32½′ tang. 9.77087
Diff. of Lat. 2 39 S.

Latitude in, 31 34 S. comp. 58 26 half 29 13 tang. 9.74762

Difference 2325

To find the difference of longitude.

As the constant logarithm	-		11.10151
is to the tangent of the course	56° 19′		10.17620
so is the diff. of log. tangents	2325		3.36642
to the difference of longitude	276.1		2 44111
Longitude Cape Voltas,	-		15° 53′E.
Difference of longitude,	-		4 36 W.
Longitude come to,	-		11 17 E.

PROB. VIII. Given one latitude, course, and difference of longitude, to find the other latitude and distance.

EXAMPLE. A ship from latitude 16° 54′N. longitude 62° 16′.W. sailed upon a NW. by N. course, until her longitude by observation is 68° 10′W. Required the distance run, and latitude come to?

Method of resolving the Problems of Mercator's Sailing.

Longitude left, - 62° 16′W.
Longitude come to, - 68 10 W.

Difference of longitude, - 5 54=354

To find the latitude come to.

As the tangent of the course	3 pts.		9.82489
is to the constant logarithm,	-		11.10151
so is the difference of longitude	354		2.54900
to the difference of log. tangents,	6693		3.82562

Lat. left, 16° 54′ comp. 73° 6′ half 36° 33′ tang. 9.87000
Diff. log. tang. 6693

Lat. in, 25 8 64 52 32 26 tang. 9.80307

Diff. of lat. 8 14=494m.

To find the distance.

As radius - -		-	10.00000
is to the secant of the course	3 points.		10.08015
so is the difference of latitude	494		2.69373
to the distance -		594.1	2.77388

PROB. IX. Given one latitude, distance, and difference of longitude, to find the course, and other latitude.

RULE. To the arithmetical complement of the logarithm of the distance, add the logarithm of the difference of longitude in minutes, and the log. cosine of the given latitude, the sum rejecting radius will be the log. sine of the approximate course.

To the given latitude taken as a course in the traverse table, and half the difference of longitude in a distance column, the corresponding departure will be the first correction of the course, which is subtractive if the given latitude is the least of the two; otherwise, additive.

In Table A, under the complement of the course, and opposite to the first correction in the side column, is the second correction. In the same table find the number answering to the course at the top, and difference of longitude in the side column; and such part of this number being taken as is found in table B opposite to the given latitude, will be the third correction. Now these two corrections, subtracted from the course corrected by the first correction, will give the true course.

Now the course and distance being known, the difference of latitude is found as formerly.

TABLE A.

Arc.	10°	20°	30°	40°	50°	60°	70°	80°	90°
1°	3′	1′	1′	1′	0′	0′	0′	0′	0′
2	12	6	4	2	2	1	1	0	0
3	27	13	8	6	4	3	2	1	0
4	47	23	14	10	7	5	3	1	0
5	74	36	23	16	11	8	5	2	0
6	107	52	33	22	16	11	7	3	0
7	145	70	44	30	21	15	9	4	0
8	190	92	58	40	28	19	12	6	0

TABLE B.

Lat.	
0°	1/3
10	1/3
20	1/6 + 1/7
30	1/6 + 1/8
40	1/6 + 1/10
50	1/4
60	1/5
70	1/6 + 1/30
80, &c.	1/6

EXAMPLE. From latitude 50° N, a ship sailed 290 miles between the south and west, and differed her longitude 5°. Required the course, and latitude come to?

Distance - -	290.	ar. co. log.	7.53760
Dif. of longitude	300	log.	2.47712
Latitude -	50°	cosine	9.80807
Approximate course	41 41	sine	9.82279

To lat. 50°, and half diff. long. 150, the 1st Corr. in a dep. column is 115 +1 55

Method of resolving the Problems of Mercator's Sailing.

In table A to co. course 48° and 1st corr. 1° 55′, the second correction is —0 2
To course 41° and diff. long 5°, the number is 6′, of which $\frac{1}{5}$ (Tab. B) being taken gives — 0 1

True course S. 43 33 W

To find the difference of latitude.

As radius		10.00000
is to the cosine of the course	43° 33′	9.86020
so is the distance	290	2.46240
to the difference of latitude	210.2	2.32260
Latitude left		50° 0′ N
Difference of latitude		3 30 S
Latitude come to		46 30 N

It was intended in this place to have given rules, to make allowance for the spheroidal figure of the earth: but as the ratio of the polar to the equatorial semiaxis is not as yet determined with sufficient accuracy, neither is it known if both hemispheres be similar figures; therefore these rules would be grounded on assumption only, and which might probably err more from the truth than those adapted to the spherical hypothesis. This therefore is supposed to be a sufficient apology for not inserting them.

Chap. VIII. *Of Oblique Sailing.*

Oblique sailing is the application of oblique angled plane triangles to the solution of problems at sea. This sailing will be found particularly useful in going along shore, and in surveying coasts and harbours, &c.

Example I. At 11h A.M. the Girdleness bore W NW, and at 2h P. M. it bore NW*b*N; the course during the interval S*b*W 5 knots an hour. Required the distance of the Ship from the Ness at each station?

By Construction.

Plate CCCXXVIII

Describe the circle NE.SW (fig. 38.) and draw the diameters NS. EW. at right angles to each other: from the centre C, which represents the first station, draw the WNW line CF; and from the same point draw CH, S*b*W, and equal to 15 miles the distance sailed.—From H draw HF in a NW*b*N direction, and the point F will represent the Girdleness. Now the distances CF, HF will measure 19.1 and 26.5 miles respectively.

By Calculation.

In the triangle FCH are given the distance CH 15 miles; the angle FCH equal to 9 points, the interval between the S*b*W and WNW points; and the angle CHF equal to 4 points, being the supplement of the angle contained between the S*b*W and NW*b*N points; hence CFH is 3 points; to find the distances CF, FH.

To find the distance CF.

As the sine of CFH	3 points	9.74474
is to the sine of CHF	4 points	9.84948
so is the distance CH	15 miles	1.17609
to the distance CF	19.07	1.28083

To find the distance FH.

As the sine of CFH	3 points	9.74474
is to the sine of FCH	9 points	9.99157
so is the distance CH	15 miles	1.17609
to the distance FH	26.48	1.42292

Oblique Sailing.

Example II. The distance between the SE point of the island of Jersey and the island of Brehaut is 13 leagues: and the correct bearing and distance of Cape Frehel from the island of Brehaut is SE*b*E 26 miles. It is also known that the SE point of Jersey bears NNE from Cape Frehel: from whence the distance of these two is required, together with the bearing of the said point from the island of Brehaut?

By Construction.

Describe a circle, (fig. 39.) and draw two diameters at right angles, the extremities of which will represent the cardinal points, north being uppermost.—Let the centre B represent Brehaut, from which draw the SE*b*E line BF equal to 26 miles, and the point F will represent Cape Frehel, from which draw the NNE line FI; make BI equal to 39 miles: Then FI applied to the scale will measure 34½ miles, and the inclination of BI to the meridian will be found equal to 63°½.

By Calculation.

In the triangle BIF are given BI and BF equal to 39 miles, and 26 miles respectively; and the angle BFI equal to 7 points: to find the side FI, and angle FBI.

To find the angle BIF.

As the distance BI	39	1.59106
is to the distance BF	26	1.41497
so is the sine of BFI	78° 45′	9.99157
to the sine of BIF	40 50	9.81548
Sum	119 35	
Angle FBI	60 25	
—— EBF	33 45	
Difference, or EBI	26 40	

Bearing of Jersey from Brehaut N63 20 E

To find the distance FI.

As the sine of BFI	78° 45′	9.99157
is to the sine of FBI	60 25	9.93934
so is the distance BI	39 miles	1.59106
to the distance FI	34.58	1.53883

Example III. At noon Dungeness bore per compass N*b*W distance 5 leagues; and having run NW*b*W 7 knots an hour, at 5 P. M. we were up with Beachyhead. Required the bearing and distance of Beachyhead from Dungeness?

By Construction.

Describe a circle (fig. 40) to represent the horizon; from the centre C draw the N*b*W line CD equal to 15 miles; and the NW*b*W line CB equal to 35 miles; join DB, which applied to the scale will measure about 26½ miles; and the inclination of DB to the meridian will be found equal to N 79°¼ W.

By Calculation.

In the triangle DBC are given the distances CD, CB equal to 15 and 35 miles respectively; and the angle BCD equal to 4 points; to find the angles B and D, and the distance BD.

Oblique Sailing.

To find the angles.

Distance CB = 35	sum of the ang.	16 points	
CD = 15	angle C	4	
Sum	50	angles B and D	12
Difference	20	half sum -	6 pts. = 67° 30′
As the sum of the distances		50	1.69897
is to their difference - -		20	1.30103
so is the tangent of half sum angles	67 30		10.38378
to the tangent of half their difference	44 0		9.98484
Angle CDB - -		111 30	
Supplement - -		68 30	
Angle NCD - -		11 15	

Magnetic bearing - N 79 45 W. Or by allowing $2\frac{1}{4}$ points of westerly variation, the true bearing of Beachy-head from Dungeness will be W $\frac{3}{4}$ S nearly.

To find the distance.

As the sine of CDB -	111° 30′		9.96868
is to the sine of BCD -	45.0		9.84948
so is the distance BC -	35		1.54407
to the distance BD - -		26.6	1.42487

Example IV. Running up Channel EbS *per* compass at the rate of 5 knots an hour. At 11^h A. M. the Eddistone light-house bore NbE$\frac{1}{4}$E and the Start point NEbE$\frac{1}{4}$E; and at 4 P. M. the Eddistone bore NWbN, and the Start N $\frac{3}{4}$ E. Required the distance and bearing of the Start from the Eddistone, the variation being $2\frac{1}{4}$ points W?

By Construction.

Plate CCCXXXVIII. Let the point C (fig. 41) represent the first station, from which draw the NbE$\frac{1}{4}$E line CA, the NEbE$\frac{1}{4}$E line CB, and the EbS line CD, which make equal to 25 miles, the distance run in the elapsed time; then from D draw the NEbN line DA intersecting CA in A, which represents the Eddistone; and from the same point draw the N$\frac{1}{4}$E line DB cutting CB in B, which therefore represents the Start. Now the distance AB applied to the scale will measure 22.9, and the bearing *per* compass BAF will measure $73\frac{01}{3}$.

By Calculation.

In the triangle CAD are given CD equal to 25 miles, the angle CAD equal to $4\frac{1}{4}$ points, the distance between NbE$\frac{1}{4}$E and NWbN; and the angle ADC equal to 4 points, the distance between the NWbN and WbN points; to find the distance CA.

As the sine of CAD	$4\frac{1}{4}$ points	-	9.86979
is to the sine of CDA	4 points	-	9.84948
so is the distance CD -	25 miles	-	1.39794
to the distance CA -	23.86	-	1.37763

In the triangle BCD, are given the distance CD 25 miles, the angle CBD $4\frac{1}{2}$ points the interval between NEbE$\frac{1}{4}$E and N$\frac{3}{4}$E; and CDB $7\frac{3}{4}$ points, the distance between WbN and N$\frac{3}{4}$E; to find the distance CD.

As the sine of CBD -	$4\frac{1}{2}$ points	-	9.88819
is to the sine of CDB	$7\frac{3}{4}$ points	-	9.99947
so is the distance CD	25 miles	-	1.39794
to the distance CB -	32.3	-	1.50922

In the triangle CAB, the distances CA, CB, are given, together with the included angle ACB, equal to 4 points, the distance between NbE$\frac{1}{4}$E and NEbE$\frac{1}{4}$E; to find the angle CAB and distance AB.

Oblique Sailing.

Distance CB 32.3	Angle ACB	= 45° 0′	
Distance CA 23.86	Sum of CAB and ABC	135 0	
Sum - 56.16	Half -	67 30	
Difference 8.44			
As the sum of the distances	56.16	-	1.74943
is to their difference -	8.44	-	0.92634
so is the tangent of half sum angles -	67 30	-	10.38278
to the tangent of half diff. angles -	19 56	-	9.55969
Angle CAB -	87 26		
Angle CAF -	14 4		

Bearing *per* compass - S 73 22E or ESE$\frac{1}{2}$E; and the variation $2\frac{1}{4}$ points being allowed to the left of ESE$\frac{1}{2}$E, gives E$\frac{1}{4}$N, the true bearing of the Start from the Eddistone.

To find the distance.

As the sine of CAB -	87° 26′	-	9.99956
is to the sine of ACB	45 0	-	9.84948
so is the distance CB -	32.3	-	1.50922
to the distance AB -	22.86		1.35914

Example V. A ship from a port in latitude 57° 9′ N, longitude 2° 9′ W, sailed 82 miles on a direct course, and spoke a ship that had run 100 miles from a port in latitude 56° 21′ N, longitude 2° 50′ W.—Required the course of each ship, and the latitude and longitude come to?

Lat. -	57° 9 N	Mer. parts	4199	Lon.	2° 9′ W
——	56 21 N	——	4112	—	2 50 W
Diff. of lat.	48	Mer. diff. lat.	87	Diff. lon.	41

By Construction.

With the meridional difference of latitude, the difference of longitude, and difference of latitude, construct the triangles ADE, ABC (fig. 42.) as in Mercator's Sailing: then A will represent the northernmost, and C the southernmost port. The distance AC applied to the scale will measure 53 miles, and the bearing BCA will be $25\frac{0}{4}$. From the points A and C, with distances equal to 82 and 100 miles respectively, describe arches intersecting each other in M, which will therefore be the place of meeting.—Now the angle ABM, the ship's course from the southernmost port, will measure N $80\frac{01}{5}$ E; and the other ship's course, or angle BAM, will be $67\frac{4}{5}$, or ESE. From M draw the parallel MNP, and AN will be the difference of latitude made by the one ship, and CP that by the other ship: hence either of these being measured and applied to its correspondent latitude, will give 56° 38′, the latitude in. Make AF equal to 57, the meridional difference of latitude between the northernmost port and latitude in: from F draw FG perpendicular to AF, and produce AM to G, then FG will be the difference of longitude, which applied to the scale will measure 139: hence the longitude in, is 0° 10′ E.

By

Oblique Sailing.

By Calculation.

In the triangles ADE, ABC, are given AD equal to 87, DE equal to 41, and AB equal to 48; to find the angle BAC and distance AC.

To find the bearing of the ports.

As the meridional diff. of lat.	87	-	1 93952
is to the diff. of long. -	41	-	1.61278
so is radius - -		-	10.00000
to the tangent of the bearing	25° 14′		9 67326

To find the distance of the ports.

As radius - -		-	10.00000
is to the secant of the bearing -	25° 14′	-	10.04355
so is the diff. of latitude	48	-	1.68124
to the distance -	53.06	-	1.72479

In the triangle AMC, the three sides are given to find the angles.

To find the angle ACM.

AM -	82			
MC -	100	ar. co. log.	-	8.00000
AC -	53.06	ar. co. log.	-	8.27523
Sum -	235.06			
Half -	117.53	- log.	-	2.07015
Difference -	35.53	- log.	-	1.55059
				19.89597
	27 29	- cosine		9.94798
Angle ACM	54 58			
Angle BAC	25 14			
Southernmost ship's course	N80 12 E			

To find the angle MAC.

As AM - - -	82	-	1.91381
is to MC - - -	100	-	2.00000
so is the sine of ACM -	54 58	-	9.91319
to the sine of MAC -	93 3	-	9.99938
Angle BAC -	25 14		
Northernmost ship's course -	S 67 49 E, or ESE.		

In the right-angled triangle AMN, given AM, and the angle MAN, to find the differences of latitude AN.

As radius - -		-	10.00000
is to the cosine of the course -	67° 49′	-	9.57700
so is the distance -	82	-	1.91381
to the diff. of lat.	30.96	-	1.49081
Latitude of northernmost port	57 9	Mer. parts	4199
Latitude in -	56 38	Mer. parts	4142
Meridional difference of latitude		-	57

To find the difference of longitude FG.

As radius - -			10.00000
is to the tangent of the course -	67° 49′	-	10.38960
so is the mer. diff. of lat.	57	-	1.75587
to the diff. of long. -	139.8	-	2.14547

Windward Sailing.

Longitude left - -	2° 9′ W
Difference of longitude -	2 20 E
Longitude in - -	0 11 E

CHAP. IX. *Of Windward Sailing.*

WINDWARD sailing is, when a ship by reason of a contrary wind is obliged to sail on different tacks in order to gain her intended port; and the object of this sailing is to find the proper course and distance to be run on each tack.

EXAMPLE I. A ship is bound to a port 48 miles directly to the windward, the wind being SSW, which it is intended to reach on two boards; and the ship can lie within 6 points of the wind. Required the course and distance on each tack?

By Construction.

Draw the SSW line CB (fig. 43.) equal to 48 miles. Make the angles ACB, ABC, each equal to 6 points. Hence the first course will be W, and the second SE: also the distance CA, or AB, applied to the scale will measure $62\frac{3}{4}$ miles, the distance to be sailed on each board. Plate cccxxxviii

By Calculation.

From A draw AD perpendicular to BC; then in the triangle ADC are given CD, equal to 24 miles; and the angle ACD, equal to 6 points, to find the distance AC.

As radius - -		-	10.00000
is to the secant of C -	6 points	-	10.41716
so is CD - -	24 miles	-	1.38021
to CA -	62.7	-	1.79737

EXAMPLE II. The wind at NW, a ship bound to a port 64 miles to the windward, proposes to reach it on three boards; two on the starboard, and one on the larboard tack, and each within 5 points of the wind. Required the course and distance on each tack?

By Construction.

Draw the NW line CA (fig. 44.) equal to 64 miles; from C draw CB W*b*S, and from A draw AD parallel thereto, and in an opposite direction; bisect AC in E, and draw BED parallel to the N*b*E rhumb, meeting CB, AD in the points B and D: then CB=AD applied to the scale will measure $36\frac{1}{4}$ miles, and BD=2CB=$72\frac{1}{2}$ miles

By Calculation.

From B draw BF perpendicular to AC; then in the triangle BFC are given the angle BCF equal to 5 points, and CF equal to one fourth of CA=16 m. to find CB.

As radius - -			10.00000
is to the secant of BCF, -	5 points		10.25526
so is CF - -	16 m.		1.20412
to CB - -	36.25		1.55938

EXAMPLE III. A ship which can lie within $5\frac{1}{2}$ points of the wind, is bound to a port 36 miles to the windward, the wind being NE*b*N, which it is intended to reach

Windward Sailing.

reach on four boards, the first being on the larboard tack. Required the course and distance on each?

By Construction.

Plate CCCXXVIII.

Draw the NE*b*N line CA (fig. 45.) equal to 36 miles, and bisect it in B; from C and B draw lines parallel to the E½S rhumb; and from A and B draw lines parallel to the SSE½E point, meeting the former in the points D and E. Now the distances AD, BD, BE, and CE, are equal; and any one of them applied to the scale will measure 19.1 miles.

By Calculation.

From E draw EF perpendicular to AC; and in the triangle CFE are given CF=9 m. and the angle FCE =5½ points, to find CE

As radius	-	-	10.00000
is to the secant of FCE	-	5½ points	10.32661
so is CF	-	9 miles	0.95424
to the distance CE	-	19.1 miles	1.28085

Example IV. A ship bound to a port bearing N*b*W distant 40 miles, with the wind at N*b*E½E, intends to reach it on two boards Required the course and distance on each tack, the ship lying within 5½ points of the wind?

By Construction.

Draw the N*b*W line CA (fig. 46.) equal to 40 miles; and because the wind is N*b*E½E, and the ship can lie within 5½ points of the wind, the course on the larboard tack will be E*b*N, and on the starboard NW. Therefore, from the centre C draw the E*b*N line CB, and from it draw the NW line AB, meeting CB in B; then CB and AB applied to the scale will measure 26 7 and 48.1 m. respectively.

By Calculation.

In the triangle ACB, given AC = 40 miles, and the angles A, B, and C, equal to 3, 5, and 8 points respectively, to find AB and BC.

To find the distance CB.

As the fine of B	-	5 points	9.91985
is to the fine of A	-	3 points	9.74474
so is the distance CA	-	40 miles	1.60206
to the distance CB	- -	26.73	1.42695

To find the distance AB.

As the fine of B	-	5 points	9 91985
is to the fine of C	-	8 points	10.00000
so is the distance CA	-	40 miles	1.60206
to the distance AB	-	48 11	1.68221

Example V. A ship close hauled within 5 points of the wind, and making one point of lee-way, is bound to a port bearing SSW, distant 54 miles, the wind being S*b*E: It is intended to make the port at three boards, the first of which must be on the larboard tack in order to avoid a reef of rocks. Required the course and distance on each tack?

By Construction.

Draw the SSW line CA (fig. 47.) equal to 54 m. and as the wind is S*b*E, and the ship makes her course good within 6 points of the wind, therefore the course on the larboard tack will be SW*b*W, and on the starboard E*b*S: hence from C draw the SW*b*W line CB, and from A draw AD parallel thereto; bisect CA in E, and draw BED parallel to the E*b*S line; then will CB and AD be the distances on the larboard tack, which applied to the scale, each will be found to measure 37.4; and the distance on the starboard tack BD will measure 42.4 miles.

Windward Sailing.

By Calculation.

The triangles CBE, EAD are equal and similar: hence in the first of these are given CE, equal to 27 miles, half the distance between the ship and port; the angles C, B, and E, equal to 3, 4, and 9 points respectively, to find CB and BE.

To find CB, the distance on the larboard tack.

As the fine of B	- -	4 points	9.84948
is to the fine of E	-	9 points	9.99157
so is the distance CE	-	27 miles	1.43136
to the distance BC	- -	37.45	1.57345

To find BE half the distance on the starboard tack.

As the fine of B	- -	4 points	9.84948
is to the fine of C	- -	3 points	9.74474
so is the distance CE	-	27 miles	1.43136
to the distance BE	-	21.21	1.32662
Whole distance AC	-	42.42	

Example VI. A ship plying to the windward, with the wind at NNE, after sailing 51 miles on each of two tacks, found by observation to have made 36 miles of difference of latitude. How near the wind did she make her way good?

By Construction.

Make CA (fig. 48.) equal to 36 miles; draw AB perpendicular to CA, and draw the NNE line CB, meeting AB in B; make CD, BD each equal to 51 miles; and these being measured, will be found equal to 6 points.

By Calculation.

In the triangles CAB, BCD, are given AB equal to 36m. CD=BD=51, and the angle ACB equal to 2 points, to find the angle BCD.

As the distance CD	-	51	1.70757
is to the diff. of latitude CA	-	18	1.25527
so is the secant of ACB	-	2 points	10.03438
to the cosine of BCD	-	67° 32′	9.58208

Example VII. A ship that makes her way good within 6½ points of the wind, reaches her port on two boards; the first being on the larboard tack 25 miles, and the other on the starboard tack 38 miles; and the difference of latitude is 21 miles north. Required the bearing of the port, and direction of the wind?

By Construction.

With the given distances 25 and 38 miles, and the included angle equal to 16−2×6½=3 points, construct the triangle BCD (fig. 49.); hence CB will be known. Draw CA equal to 21 miles, the given difference of latitude; from A draw AB perpendicular to CA, and make CB equal to what it was before determined; make DE=DC, and draw the line CE, which will represent the direction of the wind, and the angle ACB is the bearing of the port: now ACE will be found equal to 52′½, and ACB 18°.

By Calculation.

In the triangle BCD are given BC=25m. BD= 38 m. and the angle D=3 points, to find the angle BCD, and distance CB.

To

Windward Sailing.

To find the angle BCD.

Diſtance BD=38 Angle BDC 33°45′
BC=25
BCD+CBD 146 15
Sum - 63 BCD+CBD =73 7½
Difference - 13 2

As the ſum of the ſides -		63	1.79934
is to the difference of the ſides		13	1.11394
ſo is the tang. of half ſum angles	73°	7½′	10.51806
to the tang. of half diff. angles	34	13½	9.83266
Angle BCD -		107	21

To find the diſtance BC.

As the ſine of BCD -		107° 21′	9.97978
is to the ſine of BDC -		33 45	9.74474
ſo is the diſtance BD -		38	1.57978
to the diſtance BC - -		22.12	1.34474

To find the angle ACB, the bearing of the port.

As the diſtance BC -		22.12	1.34474
is to the diſtance AC - -		21.	1.32222
ſo is radius - - -			10.00000
to the coſine of ACB -		18° 17′	9.97748
Angle BCD - -		107 21	
——ACD -		125 38	
——DCE - -		73 7	
Direction of the wind	N	52 31 E	-

CHAP X. *Of Current Sailing.*

THE computations in the preceding chapters have been performed upon the aſſumption that the water has no motion. This may no doubt anſwer tolerably well in thoſe places where the ebbings and flowings are regular, as then the effect of the tide will be nearly counterbalanced. But in places where there is a conſtant current or ſetting of the ſea towards the ſame point, an allowance for the change of the ſhip's place ariſing therefrom muſt be made: And the method of reſolving theſe problems, in which the effect of a current, or heave of the ſea, is taken into conſideration, is called *current ſailing*.

In a calm, it is evident a ſhip will be carried in the direction and with the velocity of the current. Hence, if a ſhip ſails in the direction of the current, her rate will be augmented by the rate of the current; but in ſailing directly againſt it, the diſtance made good will be equal to the difference between the ſhip's rate as given by the log and that of the current. And the abſolute motion of the ſhip will be a-head, if her rate exceeds that of the current; but if leſs, the ſhip will make ſternway. If the ſhip's courſe be oblique to the current, the diſtance made good in a given time will be repreſented by the third ſide of a triangle, whereof the diſtance given by the log, and the drift of the current in the ſame time, are the other ſides; and the true courſe will be the angle contained between the meridian and the line actually deſcribed by the ſhip.

EXAMPLE I. A ſhip ſailed NNE at the rate of 8 knots an hour, during 18 hours, in a current ſetting NW*b*W 2½ miles an hour—Required the courſe and diſtance made good?

Current Sailing.

Plate CCCXXXIX.

By Conſtruction.

Draw the NNE-line CA (fig. 50). equal to 18×8 =144 miles; and from A draw AB parallel to the NW*b*W rhumb, and equal to 18×2½=45 miles: now BC being joined will be the diſtance, and NCB the courſe. The firſt of theſe will meaſure 159 miles, and the ſecond 6° 23′.

By Calculation.

In the triangle ACB, are given AC=144 miles, AB=45 miles, and the angle CAB=9 points, to find BAC and BC.

To find the courſe made good.

Diſt. AC 144 Ang. BAC=9 pts = 101° 15′
Diſt. AB 45
B+C - 78 45
Sum 189 B+C - 39 22½
Diff. 99 2

As the ſum of the ſides		189	2.27646
is to the difference of the ſides		99	1.99563
ſo is the tan. of half ſum angles	39	22½	9.91417
to the tan. of half diff. angles	23	15½	9.63334
Angle ACB -		16 7	
Angle ACN -		22 30	
Courſe made good	N	6 23 E	

To find the diſtance.

As the ſine of ACB	16°	7′	9.44341
is to the ſine of CAB	101	15	9.99157
ſo is the diſtance AB		45	1.65321
to the diſtance CB		159	2.20137

EXAMPLE II. A ſhip from a port in latitude 42° 52′ N, ſailed S*b*W½W 17 miles in 7 hours, in a current ſetting between the north and weſt; and then the ſame port bore ENE, and the ſhip's latitude by obſervation was 42° 42′ N. Required the ſetting and drift of the current?

By Conſtruction.

Draw the S*b*W½W line CA (fig. 51.) equal to 17 miles, and make CB equal to 10 miles, the difference of latitude: through B draw the parallel of latitude BD, and draw the WSW line CD, interſecting BD in D: AD being joined, will repreſent the drift of the current, which applied to the ſcale will meaſure 20.2, and the angle DAE will be its ſetting, and will be found equal to 72°.

By Calculation.

In the triangle CBD, given CB=10 miles, and the angle BCD=6 points; to find the diſtance CD.

As radius - - -			10.00000
is to the ſecant of BCD -	6 points	-	10.41710
ſo is the diff. of lat. CB -	10 miles	-	1.00000
to the diſtance CD. -	26.13	-	1.41710

Again, in the triangle ACD are given the diſtance AC=17 miles, CD=26.13, and the angle ACD 4½ points; to find the remaining parts.

To

Fig. 28.

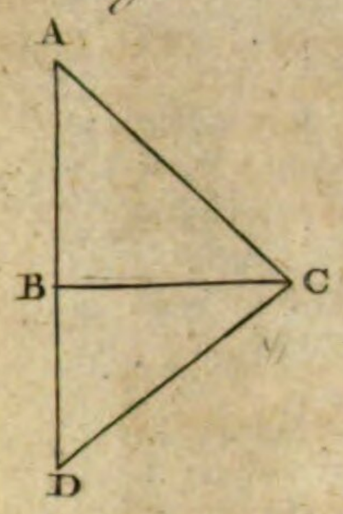


Fig. 29.

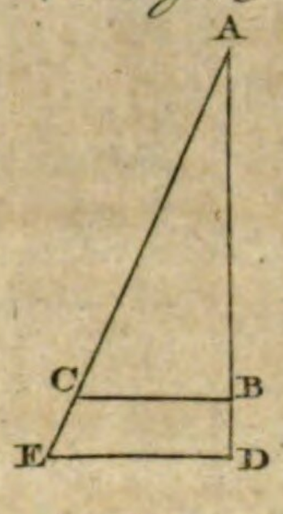


Fig. 30.

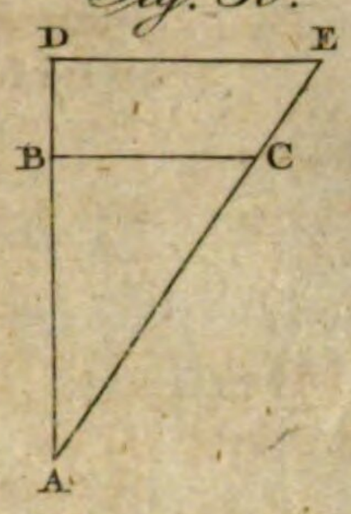


Fig. 31.

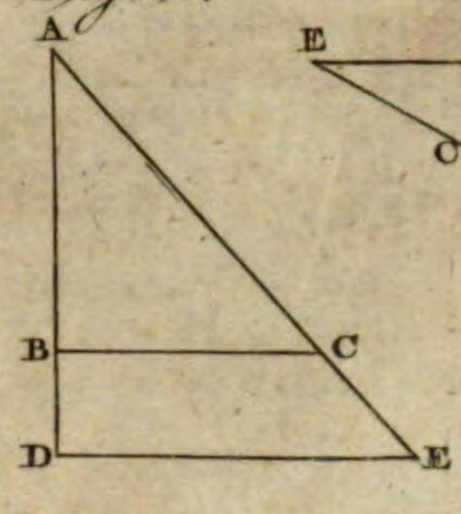


Fig. 32.

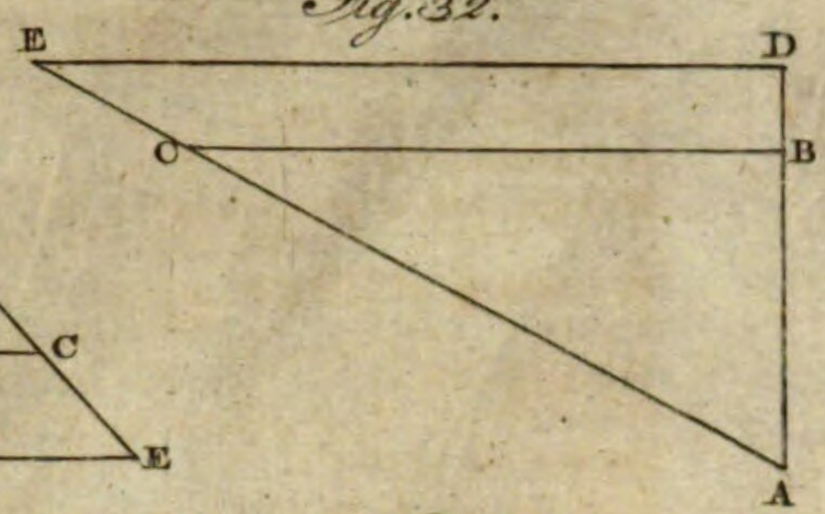


Fig. 33.

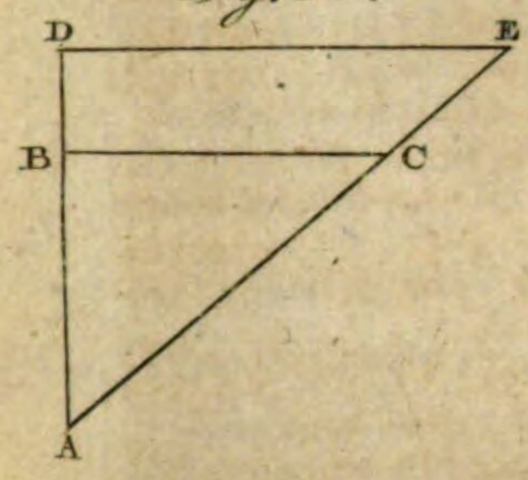


Fig. 34.

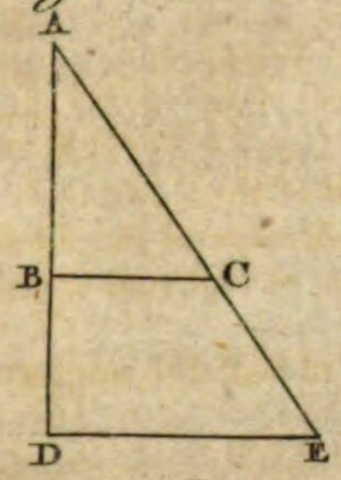
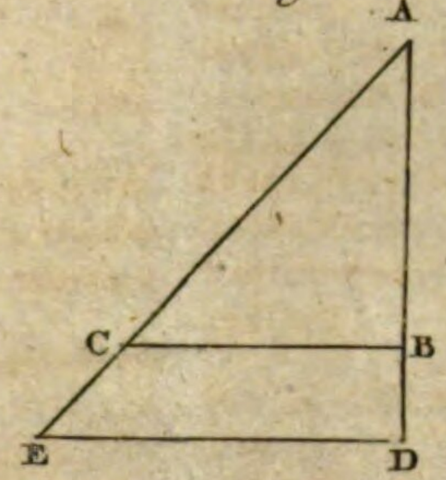


Fig. 35.



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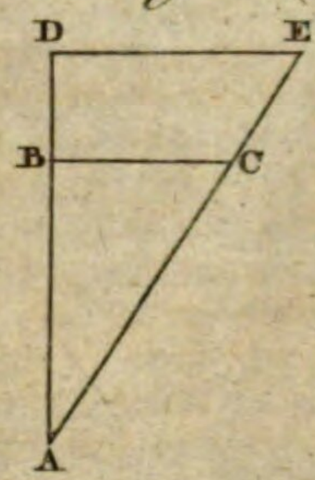

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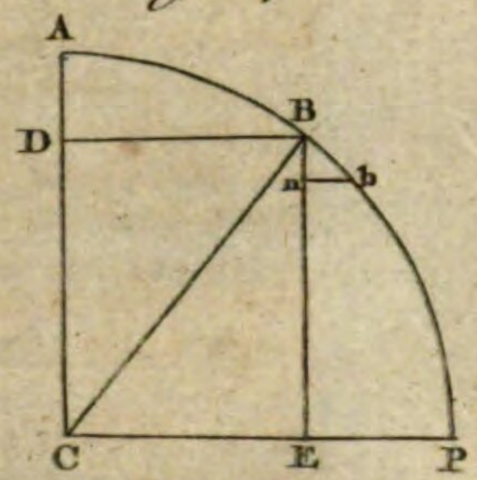


Fig. 38.

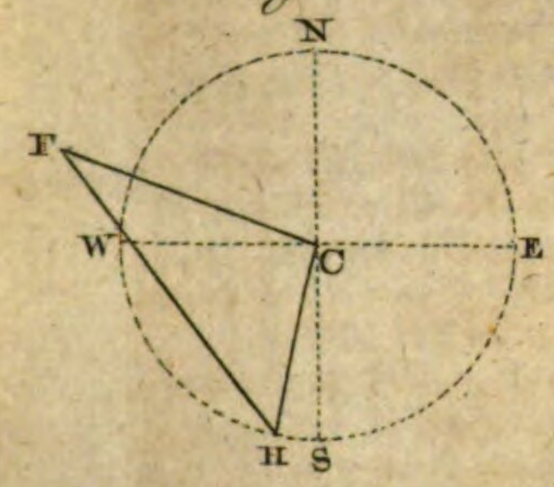
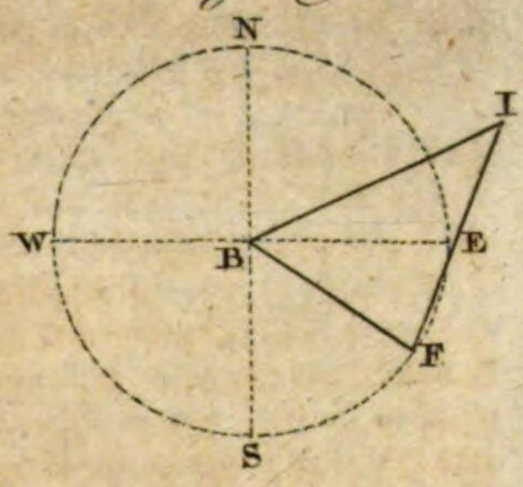


Fig. 39.



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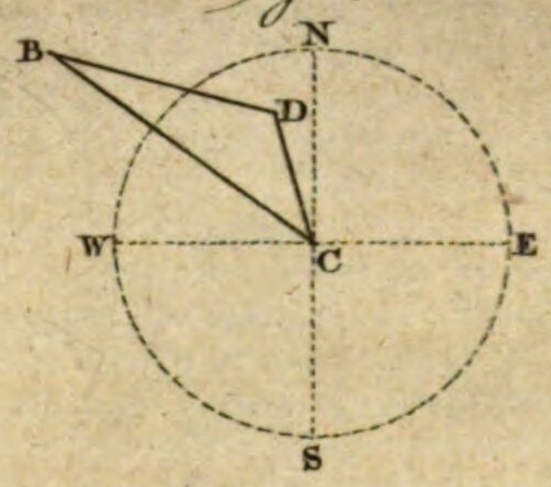

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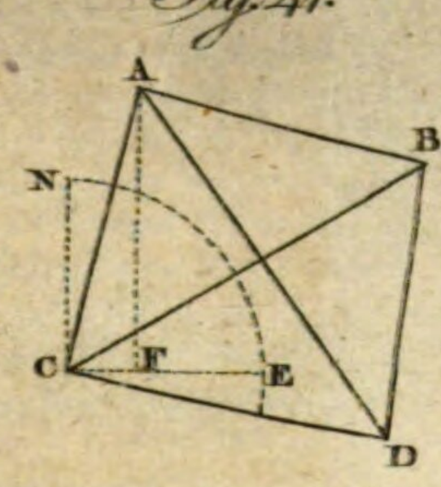


Fig. 42.

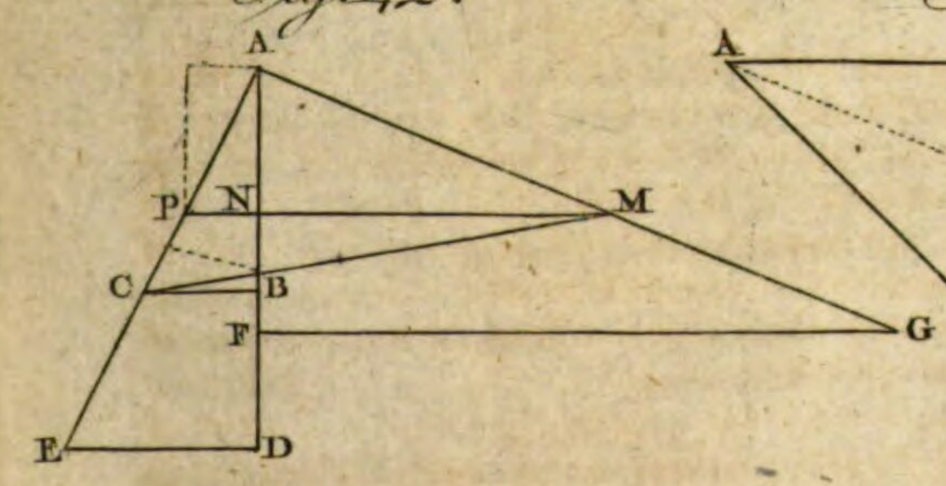


Fig. 43.

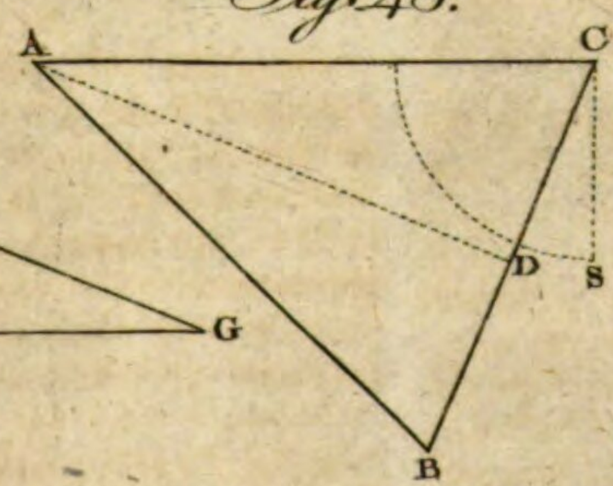


Fig. 44.

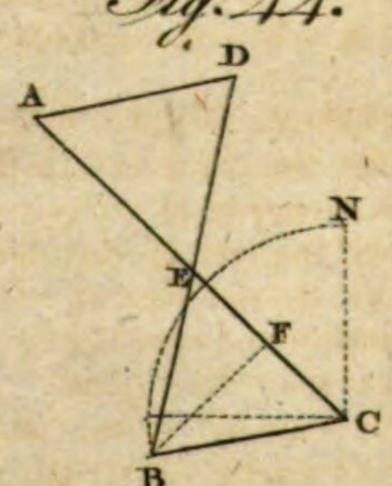


Fig. 45.

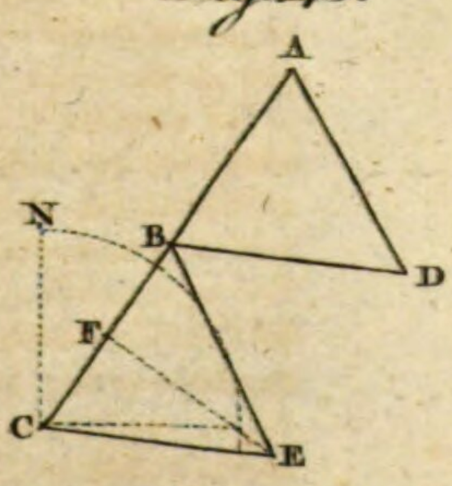


Fig. 46.

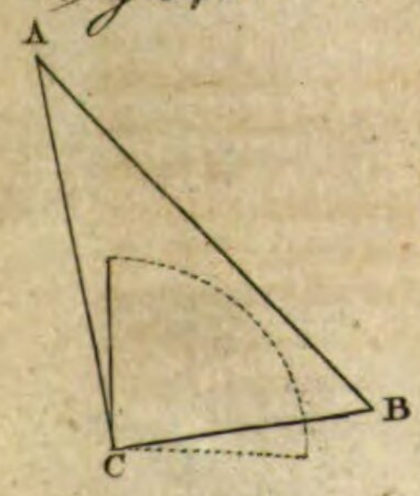


Fig. 47.

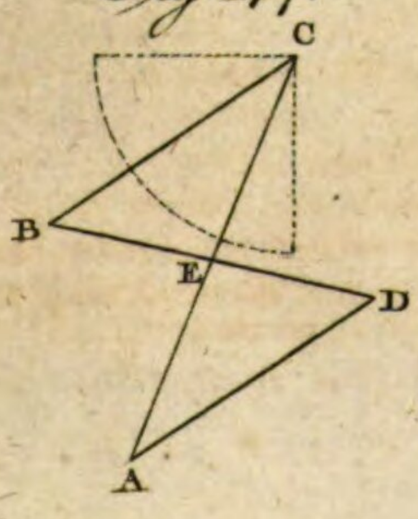


Fig. 48.

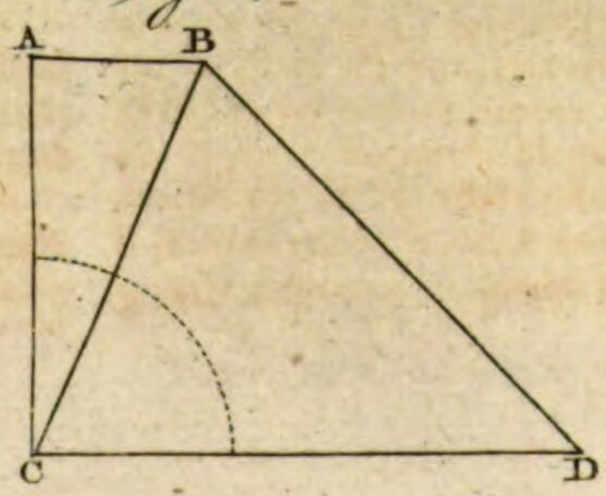
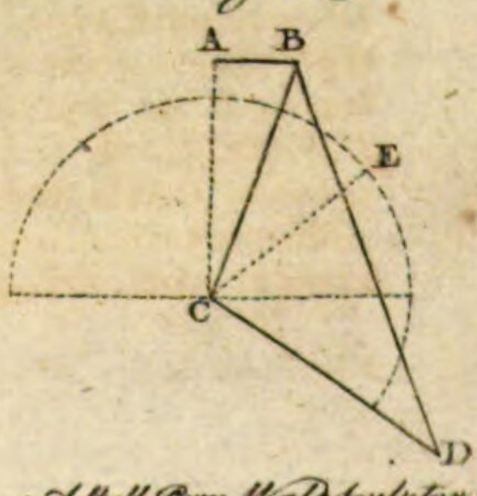


Fig. 49.



A. Bell. Prm. Wal. Sculptor. fecit.

Current Sailing.

To find the ſetting of the current.

Diſtance DC=26.13 Angle ACD=4½ points.
Diſtance AC=17. 0 CAD+CDA 11½

Sum -	43.13	CAD+CDA 5¼	=64°41′
Difference	9.13	2	
As the ſum of the ſides		43.13 -	1.63478
is to the difference of the ſides - -		9.13 -	0.96047
ſo is the tang. of half ſum angles -		64°41′ -	10.32509
to the tang. of half diff. angles -		24 6 -	9.65078
Angle CAD -		88 47	
Angle CAE=ACB=1½pt.=		16 52	
Setting of the current EAD=		71 55	

To find the drift of the current.

As the ſine of CAD -	88°47′	-	9.99990
is to the ſine of ACD	4½ points		9.88819
ſo is the diſtance CD -	26.13	-	1.41710
to the drift of currt. AD	20.2	-	1.30539

Hence the hourly rate of the current is $\frac{20.2}{7}$ = 2.9 knots.

Example III. A ſhip, from latitude 38° 20′ N, ſailed 24 hours in a current ſetting NW*b*N, and by account is in latitude 38° 42′ N, having made 44 miles of eaſting; but the latitude by obſervation is 38° 58′ N. Required the courſe and diſtance made good, and the drift of the current?

By Conſtruction.

Plate CCCXXXIX.

Make CE (fig. 52.) equal to 22 miles, the difference of latitude by D, R, and EA=44 miles, the departure, and join CA; make CD=38 miles, the difference of latitude by obſervation; draw the parallel of latitude DB, and from A draw the NW*b*N line AB, interſecting DB in B, and AB will be the drift of the current in 24 hours; CB being joined, will be the diſtance made good, and the angle DCB the true courſe. Now, AB and CB applied to the ſcale, will meaſure 19.2 and 50.5 reſpectively; and the angle DCB will be 41°¼.

By Calculation.

From B draw BF perpendicular to AE, then in the triangle AFB are given BF=16 miles, and the angle ABF=3 points; to find AB and AF.

To find the drift of the current AB.

As radius -	-		10.00000
is to the ſecant of ABF	3 points	-	10.08015
ſo is BF -	-	16 miles	1.20412
to the drift of the current AB	19.24	-	1.28427

Hence the hourly rate = $\frac{19.24}{24}$ = 0.8.

To find AF.

As radius -	-		10.00000
is to the tangent of ABF -	3 points		9.82489
ſo is BF -	-	16 -	1.20412
to AF -	-	10.69	1.02901
Departure by account EA		44.	
True departure	EF=DB=	33.31	

Now, in the triangle CDB are given the difference of latitude and departure; to find the courſe and diſtance.

Current Sailing.

To find the courſe.

As the difference of latitude CD		38.	1.57978
is to the departure DB -		33.31	1.52257
ſo is radius -	-		10.00000
to the tangent of the courſe	41°14′		9.94279

To find the diſtance.

As radius -	-		10.00000
is to the ſecant of the courſe	41°14′		10.12376
ſo is the difference of latitude	38		1.57978
to the diſtance -	-	50.53	1.70354

Example IV. In the Straits of Sunda, at 2 P. M. ſteering SE*b*S at the rate of 5 knots an hour, I paſſed cloſe by the SE of the ſmall iſlands off Hog point. At 6, not having changed our courſe, came to anchor on the Java ſhore. Upon ſetting the ſaid iſland from this anchoring place, I find it bears due north, its diſtance by the chart being 22 miles. It follows from hence, that our courſe has been affected by a current. Required its velocity and direction?

By Conſtruction.

From A (fig. 53.) draw the SE*b*S line AB=20, which will repreſent the ſhip's apparent tract through the water; draw AC equal to 22 miles ſouth, and C will be the ſhip's real place; and BC being joined will be the current's drift in four hours; which applied to the ſcale will meaſure 12.3: from A draw AD parallel to BC, and the angle CAD will be the direction of the current, and will be found to meaſure 64°½.

By Calculation.

In the triangle ABC, given AB=20 m. AC=22 m. and the included angle A=3 points; to find the remaining parts.

To find the ſetting of the current.

Diſtance AC=22 m. Included angle = 3 points.

AB=20		B+C=13	
Sum -	42	B+C / 2	=6½p=73.7½
Difference	2		
As the ſum of the ſides		42 -	1.62325
is to the difference of the ſides -		2 -	0.30103
ſo is the tangent of half ſum angles		73°7′½ -	10.51806
to the tangent of half diff. angles		8.55¼ -	9.19584
Setting of the current		S 64 12 W, or SW*b*W¾W.	

To find the drift of the current.

As the ſine of ACB -	64°12′	-	9.95440
is to the ſine of BAC	33 45	-	9.74474
ſo is the diſtance AB	20	-	1.30103
to the velocity of current BC -	12 34	-	1.09137

and $\frac{12.34}{4}$ = 3.1, its hourly rate.

Example V. A ſhip bound from Dover to Calais, lying

Current Sailing.

lying 21 miles to the SE*b*E½E, and the flood tide setting NE½E 2½ miles an hour. Required the courſe ſhe muſt ſteer, and the diſtance run by the log at 6 knots an hour to reach her port?

By Conſtruction.

Plate cccxxxix.

In the poſition of the SE*b*E½E rhumb, draw DC =21 miles (fig. 54.); draw DE NE½E=2½ miles; from E with 6 miles cut DC in F; draw DB parallel to EF, meeting CB drawn parallel to DE: then the diſtance DB applied to the ſcale will meaſure 19.4, and the courſe SDB will be SE½S.

By Calculation.

In the triangle DBF, given DE=2½ miles, EF =6 miles, and the angle EDF=6 points; to find the angle DFE=CBD.

As the hourly rate of ſailing	6 m.	0.77815
is to the hourly rate of the current	2½ m.	0.39794
ſo is the ſine of EDF=6 points	67° 30′	9.96562
to the ſine of DFE	22 38	9.58541
Angle SDC=5½ points =	61 52	
Courſe SDB	39 14=SE½S.	

In the triangle DBC, given DC=21 miles, the angle BDC=DFE=22° 38′, and the angle DCB= DEF=6 points; to find the diſtance DB.

As the ſine of DBC	89° 52′	9.99999
is to the ſine of DCB	67 30	9.96562
ſo is the true diſtance DC	21 m.	1.32222
to the diſtance by the log DB.	19.4 m.	1.28785

Example VI. A ſhip at ſea in the night has ſight of Scilly light, bearing NE*b*N, diſtant 4 leagues, it being then flood tide, ſetting ENE 2 miles an hour. What courſe and diſtance muſt the ſhip ſail to make the Lizard, which bears from Scilly E½S, diſtance 17 leagues?

By Conſtruction.

Draw the NE*b*N line AS=12 miles (fig. 55.); hence S will repreſent Scilly; from S draw SL=51 miles, and parallel to the E½S rhumb, then L will repreſent the Lizard; draw LC parallel to the ENE rhumb, and equal to 2 miles, and make CD=5 miles; from A draw AB parallel to CD, meeting LC produced in B; then AB will be the diſtance, and the angle SAB the courſe: the firſt of theſe applied to the ſcale will meaſure 41.9 miles, and the courſe will be S 88° E.

By Calculation.

In the triangle SAL are given the ſides AS, SL =12 and 51 miles reſpectively, and the angle ASL =10½ points; to find the other parts.

To find the angles.

Diſtance SL=51 m. Angle ASL=10½ points.
AS=12 m. SAL+SLA= 5½
Sum - 63 m. SAL+SLA / 2 = 2¾=30°56′
Difference 39 m.

As the ſum of the ſides	63	-	1.79934
is to the diff. of the ſides	39	-	1.59106
ſo is the tangent of half ſum angles	30° 56′	-	9.77763
to the tang. of half their difference	20 21	-	9.56935
Angle SAL	= 51 17		

NAS=3 points 33 45

NAL - - 85 2

LAE=FLA 4 58
FLB=2 points 22 30

ALB=DLC - 17 32

To find the diſtance AL.

As the ſine of SAL	51° 17′	-	9.89223
is to the ſine of ASL	10½ points		9.94543
ſo is the diſtance SL	51 miles	-	1.70757
to the diſtance AL	57.64	-	1.76077

Again, in the triangle DLC, are given the ſide DC=5 miles, the ſhip's run in an hour; LC=2 miles, the current's drift in the ſame time; and the angle DLC=17° 32′; to find the angle LDC=LAB.

As the diſt.	DC=5 miles	-	0.69897
is to the diſtance	LC=2 miles	-	0.30103
ſo is the ſine of	DLC=17° 32′	-	9.47894
to the ſine of	LDC 6 55	-	9.08100
Angle NAL	- - 85 2		
NAB	- 91 57		
Courſe	- - S 88 3 E		

In the triangle ABL, the ſide AL, together with the angles, are given, to find the diſtance AB.

As the ſine of ABL	155° 33′	-	9.61689
is to the ſine of ALB	17 32	-	9.47894
ſo is the diſtance AL	57.64		1.76077
to the diſtance AB	41.96	-	1.62282

Chap. XI. *Inſtruments propoſed to ſolve the various Problems in Sailing, independent of Calculation.*

Various methods, beſide thoſe already given, have been propoſed to ſave the trouble of calculation.—One of theſe methods is by means of an inſtrument compoſed of rulers, ſo diſpoſed as to form a right-angled triangle, having numbers in a regular progreſſion marked on their ſides. Theſe inſtruments are made of different materials, ſuch as paper, wood, braſs, &c. and are differently conſtructed, according to the fancy of the inventor. Among inſtruments of this kind, that by John Cooke, Eſq; ſeems to be the beſt. A number of other inſtruments, very differently conſtructed, have been propoſed for the ſame purpoſe; of theſe, however, we ſhall only take notice of the rectangular inſtrument, by And. Mackay, A. M. F. R. S. E.

I. *Of* Cooke's *Triangular Inſtrument.*

Deſcription. The ſtock *a b c d* (fig. 56.) is a parallelopiped: The length from *a* to *b* is two feet, the breadth from *a* to *d* two inches, and the depth is one inch and a half. The ſtock is perforated longitudinally, ſo as to be capable of containing within it *e f*, a cylindrical piece of wood one inch diameter; *g h* is an aperture on the ſurface of the ſtock about a quarter of an inch wide, which diſcloſes one-twelfth part of

Inſtruments to ſolve Problems in Sailing, independent of Calculation.

of the ſurface of the cylinder contained; the edge *dc* is divided into twelve parts, each of theſe is ſubdivided into ſix parts, and each of theſe again into ten parts. The ſurface of the cylinder is divided longitudinally into twelve parts, and on each of them is engraved a portion of a line of meridional parts 22 feet long, which contains the meridional parts for every minute from the equator as far towards the pole as navigation is practicable; and the ſmalleſt diviſion on it is not leſs than $\frac{1}{10}$th of an inch. By rolling and ſliding this cylinder, any part of any line on it may be brought into any poſition which may be required: the box *i* is engrooved into the edge of the ſtock *a b*, ſo that it may move freely from *a* to *b*; a limb from this box extends to *k*, which ſerves to mark that degree of the perpendicular *i l* which is parallel to the centre of the ſemicircle *m*; *i l* is two feet long, and graduated on both edges as the ſtock; it is perpendicular to the ſtock, and is fixed in the box *i*, by which it may be moved from *a* to *b*; *opn* is a ſemicircle of ſix inches radius, engraved, as appears in the plate, which ſlides freely from *c* to *d* in a groove in the edge of the ſtock *c d*; *m q* is the index moving on the centre *m*, the edge of which marks the courſe on the ſemicircle; it is two feet long, and divided into 72 parts; and theſe are ſubdivided in the ſame manner as thoſe on the ſtock and perpendicular, to which they are equal; *r* is a vernier attached to the index to ſhow minutes; *S* is a vernier compoſed of concentric ſemicircles, which ſlides along the edge *q m*, to the interſection of the perpendicular and index, where it ſerves as a vernier to both; below *x* is a ſmall piece of ivory, with a mark on it to point out the degree of the line *d c*, which is perpendicularly under the centre of the ſemicircle. Fig. 57. is a view of the back part of the inſtrument.

Plate ccxxxix.

Uſe. The method of working every caſe which occurs in navigation, is to make the inſtrument ſimilar to that ideal triangle which is compoſed of the difference of latitude, departure, and diſtance; or, to that compoſed of the meridional difference of latitude, difference of longitude, and enlarged diſtance; or, to that compoſed of the difference of longitude, departure, and ſine, of the middle latitude; which is done by means of the data procured from the compaſs, log-line, and quadrant: whence it follows, from the nature of ſimilar triangles, or from the relation which exiſts between the ſides of triangles and the ſines of their oppoſite angles, that the parts of the inſtrument become proportional to thoſe which they repreſent; and will aſcertain the length of the lines, or the extent of the angles ſought, by its graduations.

In the practice of this inſtrument, a ſmall ſquare is neceſſary, in order to bring the centre of the ſemicircle perpendicularly over the meridional degree correſponding to the latitude.

Plane Sailing.

PROB. I. The courſe and diſtance ſailed being given, to find the difference of latitude and departure.

EXAMPLE. A ſhip from latitude 24° 18′ N ſailed NW *b* N 168 miles. Required the latitude come to, and departure?

Set the centre of the ſemicircle perpendicularly over the given latitude 24° 18′, and the index to the courſe 3 points; move the perpendicular until it cut the index at the given diſtance 168; then at the point of interſection on the perpendicular is 93.3 miles, the departure, and on the baſe, by the edge of the box, is 26° 38′, the latitude come to.

PROB. II. Both latitudes and courſe given, to find the diſtance and departure.

EXAMPLE. Let the latitude ſailed from be 43° 50′ N, that come to 47° 8′ N, and the courſe NNE. Required the diſtance and departure?

Move the centre of the ſemicircle to the latitude left 43° 50′, and the edge of the box to the latitude come to 47° 8′; fix the index at the given courſe 2 points: then at the point of interſection of the index and perpendicular is the diſtance 214 miles on the index, and the departure 82 miles on the perpendicular.

PROB. III. Given the courſe and departure, to find the diſtance and difference of latitude.

EXAMPLE. Let the latitude ſailed from be 32°38′ N, the courſe SW*b*S, and the departure 200 miles. Required the diſtance and latitude come to?

Move the centre of the ſemicircle to the latitude left 32° 38′, ſet the index to the given courſe 3 points, and move the perpendicular till the given departure 200 cuts the index; at this point on the index is 360 miles, and the edge of the box will cut the latitude come to 27° 39′ N.

PROB. IV. Given the difference of latitude and diſtance, to find the courſe and departure.

EXAMPLE. Let the latitude left be 17° 10′ N, the latitude come to 21° 40′ N, and the diſtance ſailed on a direct courſe between the north and weſt 300 miles. Required the courſe and departure?

Move the ſemicircle and box to the given latitudes, and the index until the diſtance found thereon meets the perpendicular, then at the point of contact on the perpendicular is 130.8, the departure, and on the ſemicircle by the index is 25° 50′, the courſe.

PROB. V. The diſtance and departure given, to find the courſe and difference of latitude.

EXAMPLE. The diſtance ſailed is 246 miles between the ſouth and eaſt, the departure is 138 miles, and the latitude left 51° 10′ N. Required the courſe and latitude come to?

Set the centre of the ſemicircle to 51° 10′, the latitude ſailed from; find the diſtance 246 on the index, and the departure 138 on the perpendicular; then move both till theſe points meet, and the courſe 34° 10′ will be found on the ſemicircle by the index, and the latitude in, 47° 47′ N, by the edge of the box.

PROB. VI. Both latitudes and departure given, to find the courſe and diſtance.

EXAMPLE. A ſhip from latitude 43° 10′ N, ſailed between the north and weſt till ſhe is in latitude 47° 14′ N, and has made 170 miles of departure. Required the courſe and diſtance?

Move the centre of the ſemicircle over 43° 10′, and the edge of the box to 47° 14′; find the departure on the perpendicular, and bring the edge of the index thereto; now at the point of interſection is the diſtance 297.4 miles on the index, and the courſe 34°52′ on the ſemicircle.

Traverſe Sailing.

EXAMPLE. A ſhip from latitude 46 48′ N ſailed

Instruments to solve Problems in Sailing, independent of Calculation.

ed SSW½W 24 miles, S½W 36 miles, and S½E 40 miles. Required the latitude in, together with the direct course and distance?

Set the semicircle to the latitude sailed from 46° 48′, and the index to the course SSW½W, mark the distance 24 on the index, and bring the perpendicular to meet it; then the index will cut the departure 11.3 on the perpendicular, and the perpendicular will cut the latitude 46° 27′ N on the base. For the next course and distance, bring the semicircle to the latitude marked by the perpendicular, and lay down the course S½W: if it be towards the first meridian, move the last marked departure until it meets the index, and the limb of the box will mark the present departure; but if the course be from the first meridian, bring the last departure 11.3 to the limb of the box, the index will mark the departure made good 18.3 on the perpendicular, and the latitude arrived at 45° 52′ will be marked on the base by the perpendicular: proceed in the same manner with all the courses of which the traverse consists, then the difference of latitude 1° 36′ will be intercepted between the latitude sailed from 46° 48′, and the latitude come to 45° 12′, last marked by the perpendicular; and also the departure made good will be intercepted between that point on the perpendicular where the first departure commenced, and that where the last terminated. Now, with the difference of latitude 1° 36′ and the departure, the course will be S 8° 30′ W, and distance 97 miles, by last problem in Plane Sailing.

Parallel Sailing.

Prob. I. The difference of longitude between two places in one parallel of latitude given, to find the distance between them.

Example. Let the common latitude be 49° 30′ N, and the difference of longitude 3° 30′. Required the distance?

Set the index to 40° 30′, the complement of the latitude on the semicircle; mark the difference of longitude in miles on the index; then move the perpendicular until it meets the termination of the difference of longitude on the index, and the part of the perpendicular intercepted between the limb of the box and the point of intersection will be the distance 136.4 miles.

Prob. II. The distance between two places in one parallel of latitude given, to find the difference of longitude between them.

Example. Let the latitude of the given parallel be 49° 30′ N, the distance sailed 136.4 E. Required the difference of longitude?

Set the index to the complement of the latitude 40° 30′, and mark the distance sailed on the perpendicular; then move it until it meets the index, and the point of intersection will show the difference of longitude 210′ or 3°30′ on the index.

Prob. III. Given the distance sailed on a parallel, and the difference of longitude, to find the latitude of that parallel.

Example. The distance sailed due east is 136.4, and the difference of longitude 3° 30′. Required the latitude of the parallel?

Find the difference of longitude 210 on the index, and the distance 136.4 on the perpendicular, and move both until these numbers meet, and the complement of the latitude 40° 30′ will be shown by the index on the semicircle.

Instruments to solve Problems in Sailing, independent of Calculation.

Mercator's and Middle Latitude Sailing.

Prob. I. The latitudes and longitudes of two places given, to find the direct course and distance between them.

Example. Required the course and distance between two places whose latitudes and longitudes are 50° 50′ N, 19° 0′ W, and 54° 30′ N, 15° 30′ W, respectively?

By Mercator's Sailing.

To find the course.

Move the centre of the semicircle perpendicularly over the meridional degree answering to latitude 50° 50′ N, then move the box until the edge of the perpendicular cuts the meridional parts of the other latitude 54° 30′ N, and move the index until it cuts the difference of longitude 3° 30′ on the perpendicular, and the index will mark the course 30° 10′, or NNE¼E nearly, on the semicircle.

To find the distance.

Screw the index to this course, and move the centre of the semicircle to the latitude 50° 50′ N, and the edge of the perpendicular to the latitude 54° 30′ N, then the perpendicular will cut the distance 254.7 on the index.

By Middle Latitude Sailing.

To find the departure.

Move the centre of the semicircle to the latitude 50° 50′, and the edge of the index to the complement of the middle latitude 37° 20′ on the semicircle; then move the box until the edge of the perpendicular intersects the termination of the difference of longitude 210 miles on the index, which point of intersection will mark the departure 128 on the perpendicular.

To find the course and distance.

Move the edge of the perpendicular to the other latitude 54° 30′, and the index until it cuts the departure 128 on the perpendicular; then will the perpendicular mark the distance on the index 254.7 miles, and the index will mark the course on the semicircle 30° 10′, or NNE¼E nearly.

Prob II. Both latitudes and course given, to find the distance and difference of longitude.

Example. A ship from latitude 50° 50′ N, longitude 19° 0′ W, sailed N 30° 10′ E, until she is in latitude 54° 30′ N. Required the distance and difference of longitude?

By Mercator's Sailing.

To find the difference of longitude.

Move the box and semicircle as in the former problem to the meridional parts of the given latitudes, then set the index to the course, and it will mark the difference of longitude 3° 30′ on the perpendicular: Hence the longitude in is 15° 30′ W.

To find the distance.

Move the perpendicular and semicircle to the given latitudes, and put the index to the given course; then the perpendicular will cut the distance 254.7 miles on the index.

By Middle Latitude Sailing.

To find the distance and departure.

Move the semicircle and perpendicular to the given atitudes, and the index to the course; then the perpendicular will show the departure 128 miles, and the

Fig. 50.

Fig. 51.

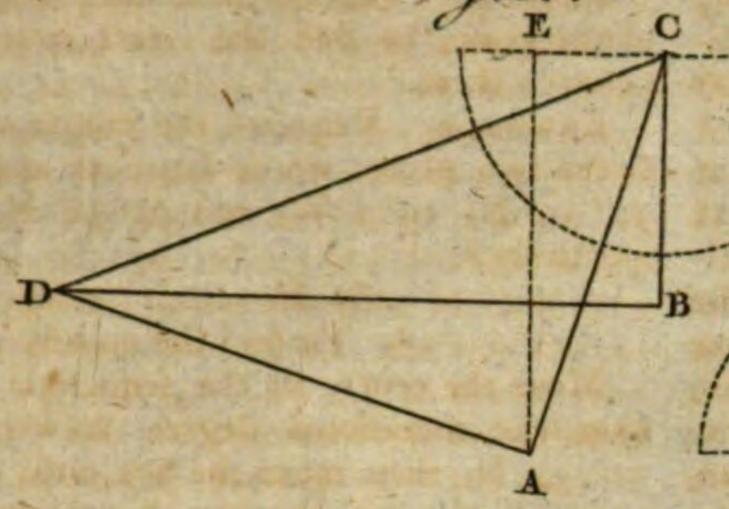


Fig. 52.

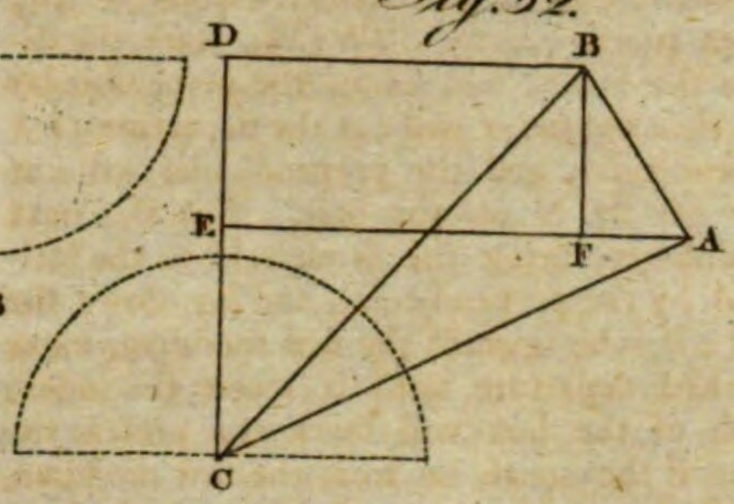


Fig. 53.

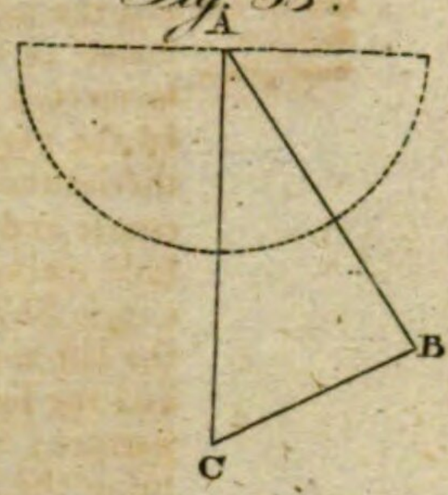


Fig. 54.

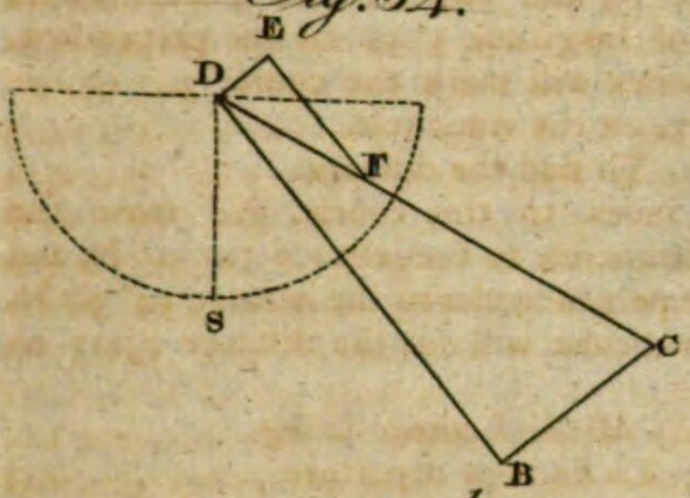


Fig. 55.

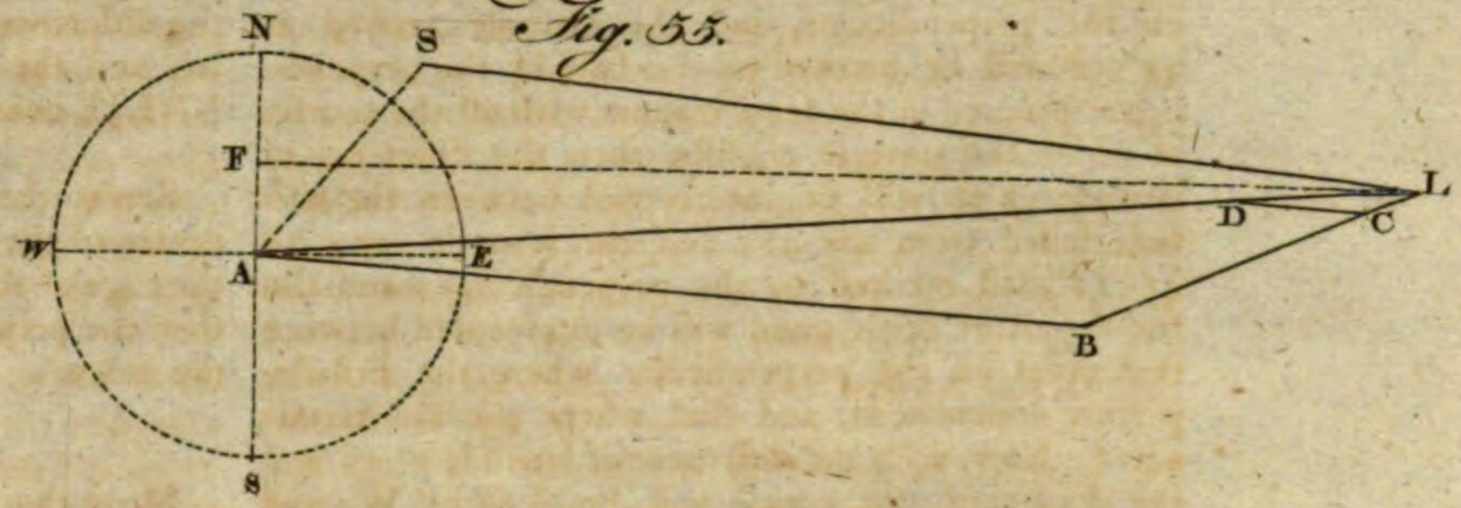


Fig. 56.

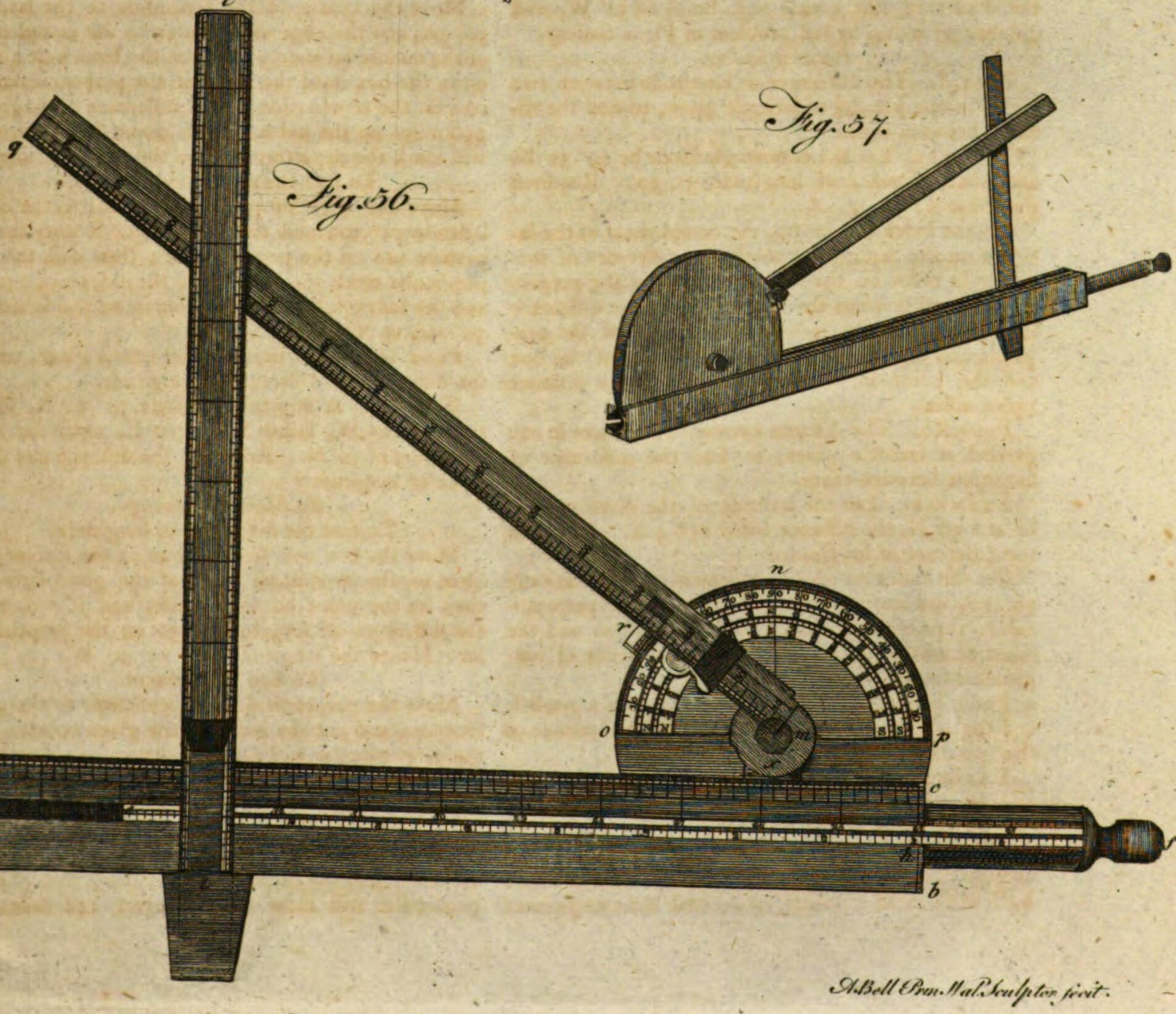


Fig. 57.

A. Bell Pinx. Mal. Sculptor fecit.

Instruments to solve Problems in Sailing, independent of Calculation.

the index the distance 254.7 miles at the point of interfection.

To find the difference of longitude.

Set the index to the complement of the middle latitude on the femicircle, and move the box until the termination of the departure on the perpendicular meets the index, which will mark the difference of longitude thereon 210 m. or 3° 30′.

Prob. III. Both latitudes and diftance given, to find the courfe and difference of longitude.

Example. From latitude 50° 50′ N, longitude 19° 0′ W, a fhip failed 254.7 miles between the north and eaft, and by obfervation is in latitude 54° 30′ N. Required the courfe and difference of longitude?

By Mercator's Sailing.

To find the courfe.

Move the perpendicular and femicircle to the given latitudes, and the index until the diftance failed marked on it meets the perpendicular; then the index will mark the courfe N 30° 10′ E on the femicircle.

To find the difference of longitude.

Screw the index to the courfe, move the perpendicular and femicircle to the meridional parts of the given latitudes, and the fpace intercepted between the limb of the box and the index will be the difference of longitude 3° 30′.

By Middle Latitude Sailing.

To find the departure and courfe.

Move the femicircle and perpendicular to the given latitudes, and the index until the diftance failed on it cuts the perpendicular; then the perpendicular will fhow the departure 128 miles, and the femicircle the courfe N 30° 10′ E.

To find the difference of longitude.

Set the index to 37° 20′, the complement of the middle latitude on the femicircle, and move the perpendicular until the termination of the departure on it cuts the index; then the point of interfection will mark the difference of longitude 210 miles on the index.

Prob. IV. Both latitudes and departure given, to find the courfe, diftance, and difference of longitude.

Example. Let the latitude and longitude failed from be 56° 40′ S and 28° 55′ E refpectively, the latitude come to 61° 20′ S, and departure 172 miles. Required the courfe, diftance, and difference of longitude?

By Mercator's Sailing.

To find the courfe and diftance.

Move the perpendicular and femicircle to the given latitudes (H); then move the index till it meets the extremity of the departure on the perpendicular; the diftance will be marked on the index 329, and the courfe S 31° 35′ E or SSE¼E nearly on the femicircle.

To find the difference of longitude.

Move the perpendicular and femicircle to the meridional parts of the given latitudes, and the index will cut the difference of longitude on the perpendicular 5° 35′.

By Middle Latitude Sailing.

The courfe and diftance are found as before.

To find the difference of longitude.

Set the index to 31°, the complement of the middle latitude on the femicircle, and move the perpendicular until the departure marked on it cuts the index, and this point of interfection will mark the difference of longitude on the index 335 m. or 5° 35′.

Prob. V. One latitude, courfe, and diftance given, to find the difference of latitude and difference of longitude.

Example. Let the latitude left be 56° 40′ S, longitude 28° 55′ E, the courfe S 31° 35′ E, and diftance 329 m. Required the latitude and longitude come to?

By Mercator's Sailing.

To find the latitude come to.

Set the femicircle to the latitude failed from, and the index to the courfe, and bring the perpendicular to the diftance, which at the fame time will mark the latitude come to 61° 20′ S.

To find the difference of longitude.

Screw the index to the courfe, and move the femicircle and perpendicular to the meridional parts of both latitudes; then the index will cut the difference of longitude on the perpendicular 5° 35′.

By Middle Latitude Sailing.

The latitude arrived at is found as above.

To find the departure.

The femicircle and perpendicular being fet to both latitudes, and the index to the courfe, it will fhow the departure 172.7 on the perpendicular.

To find the difference of longitude.

Set the index to 31°, the complement of the middle latitude on the femicircle, and move the perpendicular until the departure marked on it cuts the index, and the diviſion on the index at the point of interfection will be the difference of longitude 335.

Prob. VI. One latitude, courfe, and departure given, to find the diftance, difference of latitude, and difference of longitude.

Example. Let the latitude failed from be 56° 40′ N, longitude 28° 35′ W, the courfe N 31° 35′ W, and departure 172.7. Required the diftance, and the latitude and longitude come to?

By Mercator's Sailing.

To find the diftance and latitude come to.

Move the femicircle to the latitude left, and the index to the courfe; mark the departure on the perpendicular, and move it until the termination thereof meets the index; then the point of interfection will fhow the diftance 329 miles on the index, and the perpendicular will fhow the latitude arrived at 61° 20′ N on the bafe.

To find the difference of longitude.

Screw the index, and move the perpendicular and femicircle to the meridional parts of both latitudes, then the index will cut the difference of longitude 5° 35′ on the perpendicular.

By Middle Latitude Sailing.

Find the diftance failed and latitude in as above, and

(H) In fouthern latitudes, the end of the cylinder where the numbers begin muft be turned towards the north, pointed out by the femicircle; and in northern latitudes, it muft be reverfed.

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and the difference of longitude as in Problem IV. by middle latitude ſailing.

PROB. VII. One latitude, the diſtance ſailed, and departure given, to find the courſe, difference of latitude, and difference of longitude.

EXAMPLE. The latitude ſailed from is 48° 30′ N, and longitude 14° 40′ W, the diſtance run is 345 miles between the ſouth and eaſt, and the departure 200 miles. Required the courſe, and the latitude and longitude come to?

By Mercator's Sailing.

To find the courſe and latitude come to.

Move the ſemicircle to the latitude left, mark the diſtance on the index, and the departure on the perpendicular, move both until theſe points meet; then will the index ſhow the courſe S 35° 26′ E on the ſemicircle, and the latitude come to 43° 49′ on the baſe.

The difference of longitude is found as in the preceding problem.

By Middle Latitude Sailing.

The courſe and latitude come to are found as above, and the difference of longitude as in Problem IV. by middle latitude ſailing.

Plate CCCXL.

II. *Of* MACKAY'S *Rectangular Inſtrument.*

Deſcription. Fig. 58. is a repreſentation of this inſtrument, of about one-third of the original ſize.—The length CA is divided into 100 equal parts, and the breadth CB into 70; but in this plate every ſecond diviſion only is marked, in order to avoid confuſion; through theſe diviſions parallels are drawn, terminating at the oppoſite ſides of the inſtrument. Upon the upper and right-hand ſides are two ſcales; the firſt contains the degrees of the quadrant, and the other the points and quarters of the compaſs. M is an index moveable about the centre C, and divided in the ſame manner as the ſides (1). Fig. 59. is a portion of the enlarged meridian, ſo conſtructed that the firſt degree is equal to three diviſions on the inſtrument; and therefore, in the uſe of this line, each diviſion on the inſtrument is to be accounted 20 minutes. The ſize of the plate would not admit of the continuation of the line.

Uſe. From a bare inſpection of this inſtrument, it is evident that any triangle whatever may be formed on it. In applying it to nautical problems, the courſe is to be found at top, or right-hand ſide, in the column of degrees or points, according as it is expreſſed; the diſtance is to be found on the index, the difference of latitude at either ſide column, and the departure at the head or foot of the inſtrument. The numbers in theſe columns may repreſent miles, leagues, &c.; but when uſed in conjunction with the enlarged meridional line, then 10 is to be accounted 100 miles, 20 is to be eſteemed 200 miles, and ſo on, each number being increaſed in a tenfold ratio; and the intermediate numbers are to be reckoned accordingly.

Plane Sailing.

PROB. I. The courſe and diſtance ſailed given, to find the difference of latitude and departure.

EXAMPLE. Let the courſe be NE ½ N, diſtance 44 miles. Required the difference of latitude and departure?

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Move the index until the graduated edge be over 3½ points, and find the given diſtance 44 miles on the index: this diſtance will be found to cut the parallel of 34 miles, the difference of latitude in the ſide column, and that of 28 miles, the departure at the top.

PROB. II. Given the courſe and difference of latitude, to find the diſtance and departure.

EXAMPLE. Required the diſtance and departure anſwering to the courſe 28°, and difference of latitude 60 miles?

Lay the index over the given courſe 28°; find the difference of latitude 60 miles in the ſide column; its parallel will cut the index at 68 miles, the diſtance and the correſponding departure at the top is 32 miles.

PROB. III. The courſe and departure given, to find the diſtance and difference of latitude.

EXAMPLE. Let the courſe be SSW. and the departure 36 miles. Required the diſtance and difference of latitude?

Lay the index over two points; find the departure at the top, and its parallel will cut the index at 94 miles the diſtance, and the difference of latitude on the ſide column is 87 miles.

PROB. IV. Given the diſtance and difference of latitude, to find the courſe and departure.

EXAMPLE. The diſtance is 35 leagues, and the difference of latitude 30 leagues. Required the courſe and departure?

Bring 35 leagues on the index to the parallel of 30 leagues in the ſide; then the departure at the top is 18 leagues and the courſe by the edge of the index on the line of rhumbs is 2¾ points.

PROB V. Given the diſtance and departure, to find the courſe and difference of latitude.

EXAMPLE. Let the diſtance be 58 miles, and the departure 15 miles. Required the courſe and difference of latitude?

Move the index until 58 found thereon cuts the parallel of 15 from the top: this will be found to interſect the parallel of 56 miles, the difference of latitude; and the courſe by the edge of the ruler is 15°.

PROB. VI. The difference of latitude and departure being given, to find the courſe and diſtance.

EXAMPLE. Let the difference of latitude be 30 miles, the departure 28 miles. Required the courſe and diſtance?

Bring the index to the interſection of the parallels of 30 and 28; then the diſtance on the index is 41 miles, and the courſe by its edge is 43°.

Traverſe Sailing.

Find the difference of latitude and departure anſwering to each courſe and diſtance by Problem I. of Plane Sailing, and from thence find the difference of latitude and departure made good; with which find the courſe and diſtance by the laſt problem.

An example is unneceſſary.

Parallel

(1) In the original inſtrument are two ſlips, divided like the ſide and end of the inſtrument. One of theſe ſlips is moveable in a direction parallel to the ſide of the inſtrument, and the other parallel to the end.

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Parallel Sailing.

PROB. I. Given the difference of longitude between two places on the same parallel, to find the distance between them.

EXAMPLE. Let the latitude of a parallel be 48°, and the difference of longitude between two places on it 3° 40′, required their distance?

Put the index to 48°, the given latitude, and find the difference of longitude 220 on the index, and the corresponding parallel from the side will be 147, the distance required.

PROB. II. The latitude of a parallel, and the distance between two places on that parallel, being given, to find the difference of longitude between them.

EXAMPLE. The latitude of a parallel is 56°, and the distance between two places on it 200 miles. Required their difference of longitude?

Put the index to the given latitude, and find the distance in the side column, and the intersection of its parallel with the index will give 358, the difference of longitude sought.

PROB. III. Given the distance and difference of longitude between two places on the same parallel, to find the latitude of that parallel.

EXAMPLE. The number of miles in a degree of longitude is 46.5. Required the latitude of the parallel?

Bring 60 on the index to cut the parallel of 46.5 from the side, then the edge of the index will give 39° 11′, the latitude required.

Middle Latitude and Mercator's Sailing.

PROB. I. The latitudes and longitudes of two places being given, to find the course and distance between them.

EXAMPLE. Required the course and distance between Genoa, in latitude 44° 25′ N, longitude 8° 36′ E, and Palermo, in latitude 38° 10′ N, longitude 13° 38′ E.?

By Mercator's Sailing.

Take the interval between 38° 10′ and 44° 25′ on the enlarged meridian, which laid off from C upwards will reach to 500; now find the difference of longitude 302 at the top, and bring the divided edge of the index to the intersection of the corresponding parallels, and the index will show the course 31° 8′ on the line of degrees; then find the difference of latitude 375 on the side column, and its parallel will intersect the index at 438, the distance.

By Middle Latitude Sailing.

Put the index to 41° 18′, the complement of the middle latitude on degrees, and the difference of longitude 302 on the index will intersect the parallel of 227, the departure, in the side column. Now move the index to the intersection of the parallels of 375 and 227, the first being found in the side column, and the other at top or bottom; then the distance answering thereto on the index will be 438, and the course on the scale of degrees is 41° 10′.

PROB. II. Given one latitude, course, and distance, to find the other latitude and difference of longitude.

EXAMPLE. Let the latitude and longitude sailed from be 39° 22′ N. and 12° 8′ W. respectively, the course NNW ½ W. and distance 500 miles. Required the latitude and longitude come to?

By Mercator's Sailing.

Put the index to the course 2½ points, and find the distance 500 miles thereon; then the corresponding difference of latitude will be 441 miles, and the departure 235½ miles: hence the latitude in is 46° 43 N. Now take the interval between the latitudes of 39 22′ and 46° 43′ on the enlarged meridian, which laid off from C will reach to about 605, the parallel of which will intersect the vertical parallel of the difference of longitude 323 at the edge of the index: hence the longitude in is 17° 31′ W.

By Middle Latitude Sailing.

Find the difference of latitude and departure as before, and hence the latitude in is 46° 43′ N, and the middle latitude 43° 3′. Now put the index to 43° 3′, and the horizontal parallel of the departure 235½ will intersect the index at 322, the difference of longitude.

PROB. III. Both latitudes and course given, to find the distance and difference of longitude.

EXAMPLE. The latitude sailed from is 22° 54′ S, and longitude 42° 40′ W, the course is SE by E, and latitude come to 26° 8′ S. Required the distance sailed, and longitude in?

By Mercator's Sailing.

Bring the index to 5 points, the given course, and the parallel of 194, the difference of latitude found in the side column will intersect the index at 349, the distance; and it will cut the vertical parallel of 290, the departure.

Take the interval between the given latitudes 22° 54′ and 26° 8′ on the enlarged meridian; lay off that extent from the centre on the side column, and it will reach to 213: the parallel of this number will intersect the vertical parallel of 319, the difference of longitude. Hence the longitude in is 37° 21′ W.

By Middle Latitude Sailing.

With the given course and difference of latitude find the distance and departure as before; then bring the index to the middle latitude 24° 31′; find the departure 290 in the side column, and its parallel will intersect the index at 319, the difference of longitude.

PROB. IV. One latitude, course, and departure, given, to find the other latitude, distance, and difference of longitude.

EXAMPLE. The latitude and longitude left are 20° 30′ N. and 49° 17′ W. respectively; the course is NE ¼ N, and departure 212 miles. Required the latitude and longitude come to, and distance sailed?

By Mercator's Sailing.

Put the index to the given course 3¼ points, and the vertical parallel of 212 will cut the index at 356, the distance, and the horizontal parallel of 286, the difference of latitude; the latitude come to is therefore 25° 16′ N.

Now take the interval between the latitudes 20° 30′, and 25° 16′ on the enlarged meridian, which laid off from the centre C will reach to 311; and this parallel will intersect the vertical parallel of the difference of longitude 230, at the edge of the index. Hence the longitude in is 45° 27′ W.

By Middle Latitude Sailing.

Find the distance and difference of latitude as directed above; then bring the index to 22° 53′, the middle latitude, and the horizontal parallel of 212, the departure,

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parture, will intersect the index at 230, the difference of longitude.

Prob. V. Both latitudes and distance given, to find the course and difference of longitude.

Example. The distance sailed is 500 miles between the north and west; the latitude and longitude left are 40° 10′N, and 9° 20′W. respectively, and the latitude in is 46° 40′N. Required the course and longitude in?

By Mercator's Sailing.

Bring the distance 500 on the index to intersect the horizontal parallel of the difference of latitude 390; then the course 38° 44′ is found on the line of degrees by the edge of the index, and the vertical parallel of the above point of intersection is that answering to 313, the departure.

Take the interval between the latitudes 40° 10′, and 46° 40′, which lay off from the centre C, and its horizontal parallel will intersect the vertical parallel of 431, the difference of longitude, by the edge of the index, it being in the same position as before. Hence the longitude in is 16° 31′W.

By Middle Latitude Sailing.

The course and departure are found as formerly, and the middle latitude is 43° 25′, to which bring the edge of the index, and the horizontal parallel of 313, the departure, will intersect the index at 431, the difference of longitude.

Prob. VI. Both latitudes and departure given, to find the course, distance, and difference of longitude.

Example Let the latitude sailed from be 42° 52′N. long. 9° 17′W, the departure 250 miles W, and the latitude come to 36° 18′N. Required the course and distance sailed, and the longitude come to?

By Mercator's Sailing.

Find the point of intersection of the horizontal parallel of 394, the difference of latitude, and the vertical parallel of 250, the departure; to this point bring the index, and the corresponding division thereon will be 467 miles, and the course on the scale of degrees by the edge of the index will be 32° 24′.

Take the interval between the latitudes on the enlarged meridian; which being laid off from the centre will reach to 512: now the horizontal parallel of 512 will cut the vertical parallel of 325, the difference of longitude, at the edge of the index. The longitude come to is therefore 14° 42′ W.

By Middle Latitude Sailing.

The course and distance are to be found in the same manner as above. Then bring the index to 39° 35′, the middle latitude, and the horizontal parallel of 250 will intersect the edge of the index at 324½, the difference of longitude.

Prob. VII. Given one latitude, distance, and departure, to find the other latitude, course, and difference of longitude.

Example. A ship from latitude 32° 38′ N. longitude 17° 6′ W. sailed 586 miles between the south and west, and made 336 miles of departure:—Required the course, and the latitude and longitude come to?

Great Circle Sailing.

By Mercator's Sailing.

Move the index till the distance 586 intersects the vertical parallel of the departure 336; then the corresponding horizontal parallel will be 480, the difference of latitude, and the course 35°. Hence the latitude in is 24° 38′ N.

Now take the interval between the latitudes on the enlarged meridian, which laid off from the centre will reach to 547, the horizontal parallel of which will cut the vertical parallel of 383, the difference of longitude. The longitude in is therefore 23° 29′ W.

By Middle Latitude Sailing.

Find the course and difference of latitude as before, and hence the middle latitude is 28° 38′, to which bring the index, and the horizontal parallel of 336, the departure, will intersect the index at 383, the difference of longitude.

It seems unnecessary to enlarge any further on the use of this instrument, as the above will make it sufficiently understood.

Chap. XII. *Of Great Circle Sailing.*

The application of spherical trigonometry to the solution of triangles formed upon the surface of the earth, is called *Great Circle Sailing*.

The earth being supposed an exact sphere, the shortest distance between two places is the arch of a great circle intercepted between them; and therefore the distance sailed upon a direct course from one place to another, will always be longer than the arch of a great circle contained between them, except when the rhumb line coincides with a great circle, which can only happen when the ship sails on a meridian or on the equator.

Although it is impossible to make a ship describe an arch of a great circle, yet she may be kept so near it as to make the error almost insensible.

The terms that enter into this sailing are, the latitudes of the places, their difference of longitude and distance, and the angles contained between the distance and the meridians of the places, called the *angles of position*.

Prob. I. Given the common latitude of two places on the same parallel, and their difference of longitude, to find the distance and angle of position (κ).

Example. Required the distance between St Mary's, in latitude 36° 57 N, longitude 25° 9′ W. and Cape Henry, in latitude 36° 57′ N, and longitude 76° 27′ W.

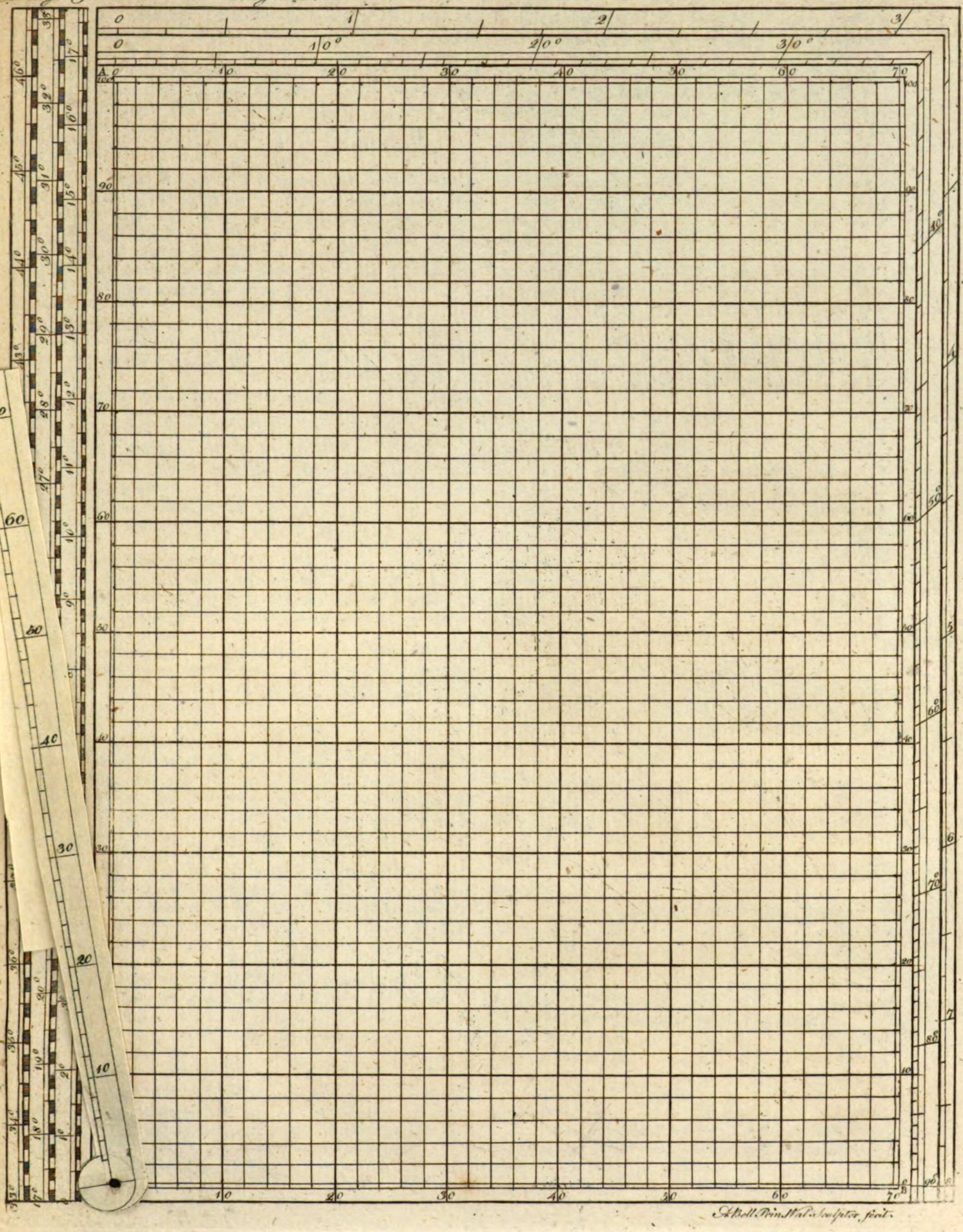
By Construction.

Describe the circle EPQS (fig. 60.) to represent the meridian of one of the places; draw the equator EQ and the earth's axis PS at right angles thereto; make ED, QA, each equal to the chord of 36° 57′, the

Plate CCCXLI.

(κ) This problem may be expressed thus:——Two places lying on the same parallel, and of these four, the latitude, difference of longitude, distance, and angle of position, any two being given to find the other two.——Now this problem contains four different cases, the most useful of which is given above. The others serve rather as exercises in spherical trigonometry than of any real utility in navigation, and are therefore omitted. The same is to be understood of the following problems.

Fig. 59. Fig. 58.



J. Bell. Pinx. Mal. Sculptor. fecit.

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the given latitude, and draw the parallel of latitude ABD, the radius of which is the tangent of 53° 3′, the co-latitude; deſcribe the meridian PBS with the ſecant of 51° 18′, the difference of longitude; then A and B will be the two places. Draw the diameter AF, and through the points ABF deſcribe a great circle; then the arch AB will be the diſtance, and the angle PAB the angle of poſition. Now theſe being meaſured by the rules given in *ſpherics*, will be found equal to 40° 28′ and 73° 54′ reſpectively.

By Calculation.

From P draw PG perpendicular to AB, by deſcribing the arch with the ſecant of half the difference of longitude; then, in the right-angled ſpherical triangle AGP, are given AP = 53° 3′, the complement of latitude, and the angle APG = 25° 39′, half the difference of longitude; to find AG half the diſtance, and PAG the angle of poſition.

1. To find the diſtance.

As radius - - -		10.00000
is to the ſine of AP	53° 3′	9 90263
ſo is the ſine of APG	25 39	9 63636
to the ſine of AG	20 14	9.53899
	2	
Diſtance AB	40 28	

2. To find the angle of poſition.

As radius - - -		10.00000
is to the coſine of AP	53° 3′	9·77896
ſo is the tangent of APG	25 39	9 68142
to the cotangent of PAG	73 54	9.46038

Prob. II. Given the latitude of a place, and the difference of longitude between it and a place on the equator, to find the diſtance between them, and the angles of poſition.

Example. Required the ſhorteſt diſtance between the iſland of St Thomas, in latitude 0° 0′, longitude 1° 0′ E, and Port St Julian, in latitude 48° 51′ S, and longitude 65° 10′ W?

By Conſtruction.

Plate CCCXLI.

Deſcribe the circle EPQS (fig. 61.), to repreſent the meridian of one of the places; draw the equator EQ, and axis PS; make EB equal to the chord of 48° 51′, and B will repreſent Port St Julian; make CA equal to the ſemitangent of the complement of the difference of longitude; draw the diameter BF, and through the points BAF draw the great circle BAF; then AB will be the diſtance, ABE the angle of poſition at Port St Julian, and BAE the complement of that at St Thomas. Theſe being meaſured by the rules given in ſpherics, will be found equal to 74° 35′, 71° 36′, and 51° 22′, reſpectively.

By Calculation

In the right-angled ſpherical triangle AEB, AE, and EB are given, to find AB and the angles A and B.

1. To find the diſtance.

As radius - - -		10.00000
is to the coſine of AE	66° 10′	9 60646
ſo is the coſine of EB.	48 51	9.81825
to the coſine of AB	74 35	9.42471

Now 74° 35′ = 4475 miles, which is 57 miles leſs than the diſtance found by Mercator's Sailing.

2. To find the angle of poſition at St Thomas.

As radius - -		10.00000
is to the ſine of AE	66° 10′	9.96129
ſo is the cotangent of EB	48 51	9.94146
to the tang. ang. of poſition	38 38	9.90275

3. To find the angle of poſition at Port St Julian.

As radius - -		10.00000
is to the ſine EB	48° 51′	9.87679
ſo is the cotangent of AE	66 10	9.64517
to the cotangent of ABE	71 36	9.52196

Hence a ſhip from St Thomas to Port St Julian muſt firſt ſteer S 38° 38′ W, and then by conſtantly altering her courſe towards the weſt, ſo as to arrive at Port St Julian on a courſe S 71° 36′ W, ſhe will have ſailed the ſhorteſt diſtance between thoſe places.

Prob. III. Given the latitudes and longitudes of two places, to find the diſtance between them, and the angles of poſition.

Example. What is the ſhorteſt diſtance between the Lizard, in latitude 49° 57′ N, longitude 5° 15′ W, and Bermudas, in latitude 32° 35′ N, and longitude 63° 28′ W?

By Conſtruction.

Deſcribe the primitive circle (fig. 62.) to repreſent the meridian of one of the places; make EA = 32° 35′, and A will repreſent Bermudas; make E*a*, Q*b* each equal to 49° 57′; then with the tangent of the co-latitude 40° 3′ draw the parallel of latitude of the Lizard, and with the ſecant of 58° 13′, the given difference of longitude, draw the oblique circle PBS, interſecting the parallel of latitude in B; which will be the poſition of the Lizard. Draw the diameter AF, and through the points A, B, F, deſcribe a circle; and the arch AB will be the diſtance, and the angles A and B the angles of poſition, which are meaſured as before.

By Calculation.

In the oblique-angled ſpherical triangle APB are AP, BP, the co-latitudes, and the angle APB the difference of longitude; to find the diſtance AB, and the angles of poſition PAB, PBA.

1. To find the diſtance.

Difference of long.	58° 13′		verſed ſine	9.67513
AP -	57 25		ſine	9.92563
BP -	40 3		ſine	9.80852
Difference	17 22	nat. v. ſine	04559	
			25661	9.40928
Diſtance AB	45 45	nat. v. ſine	30220*.	

* See *Mackay's Treatiſe on the Longitude*, where a complete Table of Nat. Verſed Sines is given.

2. To find the angle of poſition at the Lizard.

As the ſine of AB	45° 45′	9.85510
is to the ſine of AP	57 25	9.92563
ſo is the ſine of P	58 13	9.92944
to the ſine of B	89 20	9.99997

3. To find the angle of poſition at Bermudas.

As the ſine of AB	45° 45′	9.85510
is to the ſine of BP	40 3	9.80852
ſo is the ſine of P	58 13	9.92944
to the ſine of A	49 47	9.88286

The ſhorteſt diſtance between the Lizard and Bermudas is 45° 45′ or 2745 miles, which is 56 miles leſs than

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than the diſtance found by Mercator's ſailing. And a ſhip to deſcribe the ſhorteſt tract muſt ſail from the Lizard S. 89° 20′ W, and gradually leſſen the courſe, ſo as to arrive at Bermudas on the rhumb bearing S. 49° 47′ W. The direct courſe by Mercator's ſailing is S. 68° 10′ W.

From the preceding examples, it is evident that in order to ſail on the arch of a great circle, the ſhip muſt continually alter her courſe. But as this is a difficulty too great to be admitted into the practice of navigation, it has been thought ſufficiently exact to effect this by a kind of approximation; the principle of which is, that in ſmall arches the difference between the arch and its chord or tangent is ſo ſmall, that the one may be ſubſtituted for the other in any nautical operations.

Upon this principle, the great circles on the earth are ſuppoſed to be made up of ſhort right lines, each of which is a ſegment of a rhumb line: and on this ſuppoſition the ſolution to the following problem is founded.

Prob. IV. Given the latitudes and longitudes of two places, to find the ſeveral points in a great circle paſſing through them, which alter in longitude from either of the places by a given quantity; together with the courſes and diſtances between thoſe points.

Rule. Compute the diſtance of the places, and their angles of poſition, by one of the preceding problems; find alſo the perpendicular from the pole to the great circle, paſſing through the given places, and the ſeveral angles at the pole made by the given alterations of longitude between the perpendicular and the ſucceſſive meridians come to.

With this perpendicular, and the polar angles ſeverally, find as many correſponding latitudes by the following analogy:

As rad. : co-tan. perp. : : cof. 1ſt pol. ang. : tang. 1ſt lat.
: : cof. 2nd pol. ang. : tang. 2nd lat.
&c. &c.

Now having the latitudes of the ſeveral points in the great circle, and the difference of longitude between each, find the ſeveral courſes and diſtances between them; and theſe will be the courſes and diſtances the ſhip muſt run to keep nearly on the arch of a great circle.

Example 1. A ſhip from a place in latitude 37° 0′ N, longitude 23° 0′ W, bound to a place in the ſame latitude, and in longitude 76° 27′ W, intends to ſail as near the arch of a great circle as ſhe can, by altering her courſe at every five degrees of longitude. Required the latitude of each point where the courſe is propoſed to be altered, and alſo the courſes and diſtances between thoſe points?

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The triangle APB (fig. 63.) being deſcribed, and the computation made as in Problem I. the diſtance will be found equal to 42° 6′, and the angle of poſition A or B = 73° 9′.—Now the triangle APB being iſoſceles, the perpendicular PI falls in the middle of AB; and the latitudes, courſes, and diſtances being known in the half BI, thoſe in the half IA will alſo be known.

Let the points *a*, *b*, *c*, *d*, &c. be the points arrived at on each alteration of five degrees of longitude; then will the arches P*a*, P*b*, P*c*, P*d*, &c. be the reſpective co-latitudes of thoſe places, and are the hypothenuſes of the right-angled ſpherical triangles PI*a*, PI*b*, PI*c*, PI*d*, &c.

Now in the triangle PIB, given PB = 53° 0′, the angle PBI = 73° 9′, to find PI.

As radius		10.00000
is to the ſine of PBI	73° 9′	9.98094
ſo is the ſine of PB	53 0	9.90235
to the ſine of PI	49 51	9.88329

The angle IPB = $\left(\frac{53° 27'}{2}\right)$ 26° 43′½, angle 1P*a* = 21° 43′½, 1P*b* = 16° 43′½, IP*c* = 11° 43′½, IP*d* = 6° 43′½, are the ſeveral polar angles.

To find the latitude of the point *a*.

As radius		10.00000
is to the cotangent of PI	49° 51′	9.92612
ſo is the coſine firſt polar angle	21 43½	9.96800
to the tangent of 1ſt latitude	38 5	9.89412

By continuing the operation with the other polar angles, the ſucceſſive latitudes from *a* to 1 will be 38° 56′, 39° 33′, 39° 57′.

Now with the ſeveral latitudes, and reſpective differences of longitude, compute the courſes and diſtances. The reſults are entered in the following Table; the calculations being performed on a piece of waſte paper.

Polar Angles.	Succeſſive Long.	Diff. Long.	Succeſſive Lat.	Diff. Lat.	Meridian Parts.	Merid. diff. lat.	Courſes.	Diſtances.
IPB = 26° 43½	23° 0′		37° 0′		2392.6			
IP*a* = 21 43½	28 0	300	38 5	65	2474.6	82.0	74° 43′	246.6
IP*b* = 16 43½	33 0	300	38 56	51	2539.8	65.2	77 44	240.2
IP*c* = 11 43½	38 0	300	39 33	37	2587.6	47.8	80 57	235.3
IP*d* = 6 43½	43 0	300	39 57	24	2618.8	31.2	84 4	231.9
	49 43½	403.5	40 9	12	2634.5	15.7	87 46	309.1
								1263.1

The courſes, and the firſt diſtance, are found by Mercator's Sailing; but as the other courſes are near the parallel, the diſtances cannot be very exactly found by this method; another method is therefore uſed. The ſum of the diſtances is 1263.1, which doubled is 2526.2, agreeing with the diſtance found as before. It may be obſerved, that the diſtance found by this method cannot be leſs than the laſt diſtance, or that given by Great Circle Sailing, as ſome authors have found it.

Example II. A ſhip from the Lizard, in latitude 49° 57′ N, longitude 5° 15′ W, bound to a place in latitude 32° 25′ N, and longitude 66° 39′ W, propoſes to ſail on a great circle, and to alter her courſe at every

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every five degrees of longitude. Required the latitudes of the places where the ſhip is to alter her courſe, and alſo the courſe and diſtance between each?

Having deſcribed the triangle (fig. 64.) and performed the computation as in Problem III. the diſtance AB is found =47° 54′, the angle of poſition PBA at the Lizard 87° 15′, and that at the place bound to 49° 35′.

Draw PI at right angles to AB, and in the equator lay off from the centre the tangents of 5, 10, 15, 20, &c. to 55 degrees, and theſe will be the centres of the arches of co-latitude to every 5° of difference of longitude.

To find the perpendicular PI.

As radius		10.00000
is to the ſine of PAB	49° 35′	9.88158
ſo is the ſine of PA	57 35	9.92643
to the ſine of PI	40 0	9.80801

To find the polar angle API.

As radius		10.00000
is to the coſine of AP	57° 35′	9.72922
ſo is the tangent of PAB	49 35	10.06978
to the co-tangent of API	57 49	9.79900

Now the polar angle API, or the difference of longitude between the perpendicular and the meridian of the place bound to, 57° 49′, being taken from 61° 24′, the whole difference of longitude, leaves 3° 35′ for the difference of longitude between the Lizard and the perpendicular; alſo 5°, the propoſed alteration of longitude, being ſubtracted as often as it can be from 57° 49′, leaves the ſeveral polar angles; with which and the perpendicular PI the ſeveral latitudes arrived at are found as in the preceding example: then with theſe latitudes and the differences of longitude between them, find the ſucceſſive courſes and diſtances. The ſeveral reſults are placed in the following Table; the calculations being performed on a piece of waſte paper.

Polar Angles.	Succeſſive Longs.	Diff. Long.	Succeſſive Lats.	Diff. Lat.	Meridian Parts.	Merid. diff. lat.	Courſes.	Diſtances.
	5° 14′		49° 57′		3469.8			
IPB= 3° 35′	8 49	215	50 0	3	3474.5	4.7	88° 45′	138.3
IP*a* = 2 49	11 38	169	49 58	2	3471.4	3.1	88 57	108.7
IP*b* = 7 49	16 38	300	49 45	13	3451.2	20.2	86 9	193.8
IP*c* =12 49	21 38	300	49 18	27	3409.6	41.6	82 6	196.6
IP*d* =17 49	26 38	300	48 37	41	3347.2	62.4	78 15	201.4
IP*e* =22 49	31 38	300	47 42	55	3264.7	82.5	74 37	207.3
IP*f* =27 49	36 38	300	46 31	71	3160.4	104.3	70 50	216.3
IP*g* =32 49	41 38	300	45 3	88	3034.2	126.2	67 10	226.8
IP*h* =37 49	46 38	300	43 17	106	2886.4	147.8	63 46	239.8
IP*i* =42 49	51 38	300	41 10	127	2714.9	171.5	60 15	255.9
IP*k* =47 49	56 38	300	38 41	149	2520.5	194.4	57 3	273.9
IP*l* =52 49	61 38	300	35 46	175	2300.7	219.8	53 46	296.1
	66 38	300	32 25	201	2058.0	242.7	51 2	319.6
								2874.5

As the four firſt courſes are near the parallel, the correſponding diſtances were not found by Mercator's Sailing. The ſum of the diſtances 2874.5 agrees very well with, and is not leſs than, 47° 54′, or 2874 miles, the ſhorteſt diſtance between the places.

CHAP. XIII. *Of Sea-Charts.*

The charts uſually employed in the practice of navigation are of two kinds, namely, *Plane* and *Mercator's Charts*. The firſt of theſe is adapted to repreſent a portion of the earth's ſurface near the equator; and the laſt for all portions of the earth's ſurface. For a particular deſcription of theſe, reference has already been made from the article CHART, to thoſe of PLANE and MERCATOR: and as theſe charts are particularly deſcribed under the above articles, it is therefore ſufficient in this place to deſcribe their uſe.

Uſe of the Plane Chart.

PROB. I. To find the latitude of a place on the chart.

RULE. Take the leaſt diſtance between the given place and the neareſt parallel of latitude; now this diſtance applied the ſame way on the graduated meridian, from the extremity of the parallel, will give the latitude of the propoſed place.

Thus the diſtance between Bonaviſta and the parallel of 15 degrees, being laid from that parallel upon the graduated meridian, will reach to 16° 5′, the latitude required.

PROB. II. To find the courſe and diſtance between two given places on the chart.

RULE. Lay a ruler over the given places, and take the neareſt diſtance between the centre of any of the compaſſes on the chart and the edge of the ruler; move this extent along, ſo as one point of the compaſs may touch the edge of the rule, and the ſtraight line joining their points may be perpendicular thereto; then will the other point ſhow the courſe: The interval between the places, being applied to the ſcale, will give the required diſtance.

Thus the courſe from Palma to St Vincent will be found to be about SSW ¼ W. and the diſtance 13°¼ or 795 m.

PROB. III. The courſe and diſtance ſailed from a known place being given, to find the ſhip's place on the chart.

RULE. Lay a ruler over the place ſailed from, pa-

Sea-Charts.

rallel to the rhumb, expreſſing the given courſe; take the diſtance from the ſcale, and lay it off from the given place by the edge of the ruler; and it will give the point repreſenting the ſhip's preſent place.

Thus, ſuppoſe a ſhip had ſailed SW*b*W 160 miles from Cape Palmas; then by proceeding as above, it will be found that ſhe is in latitude 2° 57′ N.

The various other problems that may be reſolved by means of this chart require no further explanation, being only the conſtruction of the remaining problems in Plane Sailing on the chart.

Uſe of Mercator's Chart.

The method of finding the latitude and longitude of a place, and the courſe or bearing between two given places by this chart, is performed exactly in the manner as in the Plane Chart, which ſee.

Prob. I. To find the diſtance between two given places on the chart.

Case I. When the given places are under the ſame meridian.

Rule. The difference or ſum of their latitudes, according as they are on the ſame or on oppoſite ſides of the equator, will be the diſtance required.

Case II. When the given places are under the ſame parallel.

Rule. If that parallel be the equator, the difference or ſum of their longitudes is the diſtance; otherwiſe, take half the interval between the places, lay it off upwards and downwards on the meridian from the given parallel, and the intercepted degrees will be the diſtance between the places.

Or, take an equal extent of a few degrees from the meridian on each ſide of the parallel, and the number of extents, and parts of an extent, contained between the places, being multiplied by the length of an extent, will give the required diſtance.

Case III. When the given places differ both in latitude and longitude.

Rule. Find the difference of latitude between the given places, and take it from the equator or graduated parallel; then lay a ruler over the two places, and move one point of the compaſs along the edge of the ruler until the other point juſt touches a parallel; then the diſtance between the place where the point of the compaſs reſted by the edge of the ruler, and the point of interſection of the ruler and parallel, being applied to the equator, will give the diſtance between the places in degrees and parts of a degree, which multiplied by 60 will reduce it to miles.

Prob. II. Given the latitude and longitude in, to find the ſhip's place on the chart.

Rule. Lay a ruler over the given latitude, and lay off the given longitude from the firſt meridian by the edge of the ruler, and the ſhip's preſent place will be obtained.

Prob. III. Given the courſe ſailed from a known place, and the latitude in, to find the ſhip's preſent place on the chart.

Rule. Lay a ruler over the place ſailed from, in the direction of the given courſe, and its interſection with the parallel of latitude arrived at will be the ſhip's preſent place.

Prob. IV. Given the latitude of the place left and the courſe and diſtance ſailed, to find the ſhip's preſent place on the chart.

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Rule. The ruler being laid over the place ſailed from and in the direction of the given courſe, take the diſtance ſailed from the equator, put one point of the compaſs at the interſection of any parallel with the ruler, and the other point of the compaſs will reach to a certain place by the edge of the ruler. Now this point remaining in the ſame poſition, draw in the other point of the compaſs until it juſt touch the above parallel when ſweeped round: apply this extent to the equator, and it will give the difference of latitude. Hence the latitude in will be known, and the interſection of the correſponding parallel with the edge of the ruler will be the ſhip's preſent place.

The other problems of Mercator's Sailing may be very eaſily reſolved by this chart; but as they are of leſs uſe than thoſe given, they are therefore omitted, and may ſerve as an exerciſe to the ſtudent.

BOOK II.

Containing the method of finding the Latitude and Longitude of a Ship at Sea, and the Variation of the Compaſs.

Chap. I. *Of Hadley's Quadrant.*

Hadley's quadrant is the chief inſtrument in uſe at preſent for obſerving altitudes at ſea. The form of this inſtrument, a ccording to the preſent mode of conſtruction, is an octagonal ſector of a circle, and therefore contains 45 degrees; but becauſe of the double reflection, the limb is divided into 90 degrees. See Astronomy and Quadrant. Fig. 65 repreſents a quadrant of the common conſtruction, of which the following are the principal parts. Plate CCCXLI.

1. ABC, the frame of the quadrant.
2. BC, the arch or limb.
3. D, the index; *a b*, the ſubdividing ſcale.
4. E, the index-glaſs.
5. F, the fore horizon-glaſs.
6. G, the back horizon-glaſs.
7. K, the coloured or dark glaſſes.
8. HI, the vanes or ſights.

Of the Frame of the Quadrant.

The frame of the quadrant conſiſts of an arch BC, firmly attached to the two radii AB, AC, which are bound together by the braces L M, in order to ſtrengthen it, and prevent it from warping.

Of the Index D.

The index is a flat bar of braſs, and turns on the centre of the octant: at the lower end of the index there is an oblong opening; to one ſide of this opening the vernier ſcale is fixed, to ſubdivide the diviſions of the arch; at the end of the index there is a piece of braſs, which bends under the arch, carrying a ſpring to make the ſubdividing ſcale lie cloſe to the diviſions. It is alſo furniſhed with a ſcrew to fix the index in any deſired poſition. The beſt inſtruments have an adjuſting ſcrew fitted to the index, that it may be moved more ſlowly, and with greater regularity and accuracy, than by the hand. It is proper, however, to obſerve, that the index muſt be previouſly fixed near its right poſition by the above-mentioned ſcrew.

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Of the Index Glaſs E.

Upon the index, and near its axis of motion, is fixed a plane ſpeculum, or mirror of glaſs quickſilvered. It is ſet in a braſs frame, and is placed ſo that its face is perpendicular to the plane of the inſtrument. This mirror being fixed to the index moves along with it, and has its direction changed by the motion thereof; and the intention of this glaſs is to receive the image of the ſun, or any other object, and reflect it upon either of the two horizon-glaſſes, according to the nature of the obſervation.

The braſs frame with the glaſs is fixed to the index by the ſcrew *c*; the other ſcrew ſerves to re-place it in a perpendicular poſition, if by any accident it has been deranged.

Of the Horizon Glaſſes F, G.

On the radius AB of the octant are two ſmall ſpeculums: the ſurface of the upper one is parallel to the index glaſs, and that of the lower one perpendicular thereto, when *o* on the index coincides with *o* on the limb. Theſe mirrors receive the reflected rays, and tranſmit them to the obſerver.

The horizon-glaſſes are not entirely quickſilvered; the upper one F is only ſilvered on its lower half, or that next the plane of the quadrant, the other half being left tranſparent, and the back part of the frame cut away, that nothing may impede the ſight through the unſilvered part of the glaſs. The edge of the foil of this glaſs is nearly parallel to the plane of the inſtrument, and ought to be very ſharp, and without a flaw. The other horizon-glaſs is ſilvered at both ends. In the middle there is a tranſparent ſlit, through which the horizon may be ſeen.

Each of theſe glaſſes is ſet in a braſs frame, to which there is an axis paſſing through the wood work, and is fitted to a lever on the under ſide of the quadrant, by which the glaſs may be turned a few degrees on its axis, in order to ſet it parallel to the index-glaſs. The lever has a contrivance to turn it ſlowly, and a button to fix it. To ſet the glaſſes perpendicular to the plane of the inſtrument, there are two ſunk ſcrews, one before and one behind each glaſs: theſe ſcrews paſs through the plate on which the frame is fixed into another plate; ſo that by looſening one and tightening the other of theſe ſcrews, the direction of the frame with its mirror may be altered, and ſet perpendicular to the plane of the inſtrument.

Of the Coloured Glaſſes K.

There are uſually three coloured glaſſes, two of which are tinged red and the other green. They are uſed to prevent the ſolar rays from hurting the eye at the time of obſervation. Theſe glaſſes are ſet in a frame, which turns on a centre, ſo that they may be uſed ſeparately or together as the brightneſs of the ſun may require. The green glaſs is particularly uſeful in obſervations of the moon; it may be alſo uſed in obſervations of the ſun, if that object be very faint. In the fore-obſervation, theſe glaſſes are fixed as in fig. 65. but when the back obſervation is uſed, they are removed to N.

Plate CCCXLI.

Of the two Sight Vanes H, I.

Each of theſe vanes is a perforated piece of braſs, deſigned to direct the ſight parallel to the plane of the quadrant. That which is fixed at I is uſed for the fore, and the other for the back, obſervation. The vane I has two holes, one exactly at the height of the ſilvered part of the horizon-glaſs, the other a little higher, to direct the ſight to the middle of the tranſparent part of the mirror.

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Of the Diviſions on the Limb of the Quadrant.

The limb of the quadrant is divided from right to left into 90 primary diviſions, which are to be conſidered as degrees, and each degree is ſubdivided into three equal parts, which are therefore of 20 minutes each: the intermediate minutes are obtained by means of the ſcale of diviſions at the end of the index.

Of the Vernier or ſubdividing Scale.

The dividing ſcale contains a ſpace equal to 21 diviſions of the limb, and is divided into 20 equal parts. Hence the difference between a diviſion on the dividing ſcale and a diviſion on the limb is one-twentieth of a diviſion on the limb, or one minute. The degree and minute pointed out by the dividing ſcale may be eaſily found thus.

Obſerve what minute on the dividing ſcale coincides with a diviſion on the limb; this diviſion being added to the degree and part of a degree on the limb, immediately preceding the firſt diviſion on the dividing ſcale, will be the degree and minute required.

Thus ſuppoſe the fourteenth minute on the dividing ſcale coincided with a diviſion on the limb, and that the preceding diviſion on the limb to *o* on the vernier was 56° 40′; hence the diviſion ſhown by the vernier is 56° 54′. A magnifying glaſs will aſſiſt the obſerver to read off the coinciding diviſions with more accuracy.

Adjuſtments of Hadley's Quadrant.

The adjuſtments of the quadrant conſiſt in placing the mirrors perpendicular to the plane of the inſtrument. The fore horizon-glaſs muſt be ſet parallel to the ſpeculum, and the planes of the ſpeculum and back horizon glaſs produced muſt be perpendicular to each other when the index is at *o*.

Adjustment I. To ſet the index-glaſs perpendicular to the plane of the quadrant.

Method I. Set the index towards the middle of the limb, and hold the quadrant ſo that its plane may be nearly parallel to the horizon: then look into the index-glaſs; and if the portion of the limb ſeen by reflection appears in the ſame plane with that ſeen directly, the ſpeculum is perpendicular to the plane of the inſtrument. If they do not appear in the ſame plane, the error is to be rectified by altering the poſition of the ſcrews behind the frame of the glaſs.

Method II. This is performed by means of the two adjuſting tools fig. 66, 67, which are two wooden frames, having two lines on each, exactly at the ſame diſtance from the bottom.

Place the quadrant in an horizontal poſition on a table; put the index about the middle of the arch; turn back the dark glaſſes; place one of the above-mentioned tools near one end of the arch, and the other at the oppoſite end, the ſide with the lines being towards the index-glaſs; then look into the index-glaſs, directing the ſight parallel to the plane of the inſtrument, and one of the tools will be ſeen by direct viſion, and the other by reflection. By moving the index a little, they may be brought exactly together.

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ther. If the lines coincide, the position of the mirror is right; if not, they must be made to coincide by altering the screws behind the frame, as before.

ADJUSTMENT II. To set the fore horizon-glass perpendicular to the plane of the instrument.

Set the index to *o*; hold the plane of the quadrant parallel to the horizon; direct the sight to the horizon, and if the horizons seen directly and by reflection are apparently in the same straight line, the fore horizon-glass is perpendicular to the plane of the instrument; if not, one of the horizons will appear higher than the other. Now if the horizon seen by reflection is higher than that seen directly, release the nearest screw in the pedestal of the glass, and screw up that on the farther side, till the direct and reflected horizons appear to make one continued straight line. But if the reflected horizon is lower than that seen directly, unscrew the farthest, and screw up the nearest screw till the coincidence of the horizons is perfect, observing to leave both screws equally tight, and the fore horizon-glass will be perpendicular to the plane of the quadrant.

ADJUSTMENT III. To set the fore horizon-glass parallel to the index-glass, the index being at *o*.

Set *o* on the index exactly to *o* on the limb, and fix it in that position by the screw at the under side; hold the plane of the quadrant in a vertical position, and direct the sight to a well-defined part of the horizon; then if the horizon seen in the silvered part coincides with that seen through the transparent part, the horizon-glass is adjusted; but if the horizons do not coincide, unscrew the milled screw in the middle of the lever on the other side of the quadrant, and turn the nut at the end of the lever until both horizons coincide, and fix the lever in this position by tightening the milled screw.

As the position of the glass is liable to be altered by fixing the lever, it will therefore be necessary to re-examine it, and if the horizons do not coincide, it will be necessary either to repeat the adjustment, or rather to find the error of adjustment, or, as it is usually called, the *index-error*; which may be done thus:

Direct the sight to the horizon, and move the index until the reflected horizon coincides with that seen directly; then the difference between *o* on the limb and *o* on the vernier is the index error; which is additive when the beginning of the vernier is to the right of *o* on the limb, otherwise subtractive.

ADJUSTMENT IV. To set the back horizon-glass perpendicular to the plane of the instrument.

Put the index to *o*; hold the plane of the quadrant parallel to the horizon, and direct the sight to the horizon through the back sight vane. Now if the reflected horizon is in the same straight line with that seen through the transparent part, the glass is perpendicular to the plane of the instrument: If the horizons do not unite, turn the sunk screws in the pedestal of the glass until they are apparently in the same straight line.

ADJUSTMENT V. To set the back horizon-glass perpendicular to the plane of the index-glass produced, the index being at *o*.

Let the index be put as much to the right of *o* as twice the dip of the horizon amounts to; hold the quadrant in a vertical position, and apply the eye to the back vane: then if the reflected horizon coincides with that seen directly, the glass is adjusted; if they do not coincide, the screw in the middle of the lever on the other side of the quadrant must be released, and the nut at its extremity turned till both horizons coincide. It may be observed, that the reflected horizon will be inverted; that is, the sea will be apparently uppermost and the sky lowermost.

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As this method of adjustment is esteemed troublesome, and is often found to be very difficult to perform at sea, various contrivances have therefore been proposed to render this adjustment more simple. Some of these are the following.

1. Mr Dollond's method of adjusting the back horizon-glass.

In this method an index is applied to the back horizon-glass, by which it may be moved so as to be parallel to the index-glass, when *o* on the vernier coincides with *o* on the limb. When this is effected, the index of the back horizon-glass is to be moved exactly 90° from its former position, which is known by means of a divided arch for that purpose; and then the plane of the back horizon-glass will be perpendicular to the plane of the index-glass produced.

2. Mr Blair's method of adjusting the back horizon-glass.

All that is required in this method is to polish the lower edge of the index-glass, and expose it to view. The back horizon-glass is adjusted by means of a reflection from this polished edge, in the very same method as the fore horizon-glass is adjusted by the common method.

Plate CCCXLII.

In order to illustrate this, let R I H E (fig. 68.) represent a pencil of rays emitted from the object R, incident on the index-glass I, from which it is reflected to the fore horizon-glass H, and thence to the eye at E. By this double reflection, an image of the object is formed at *r*. RHE represents another pencil from the same object R, coming directly through the fore horizon-glass to the eye at E; so that the doubly reflected image *r* appears coincident with the object R itself, seen directly.

When this coincidence is perfect, and the object R so very distant as to make the angle IRH insensible, the position of the speculums I and H will differ insensibly from parallelism; that is, the quadrant will be adjusted for the fore observation. Now it is from the ease and accuracy with which this adjustment can at any time be made, that the fore-observation derives its superiority over the back-observation. But by grinding the edge of the index glass perpendicular to its reflecting surface, and polishing it, the back-observation is rendered capable of an adjustment equally easy and accurate as the fore horizon-glass: for by a pencil of rays emitted from the object S, incident on the reflecting edge of the index-glass D, thence reflected to the back horizon-glass B, and from that to the eye at *e*, an image will be formed at *s*; which image being made to coincide with the object S itself, seen directly, ascertains the position of the back horizon glass relative to the index-glass with the same precision, and in a manner equally direct, as the former operation does that of the fore horizon-glass.

Directions for adjusting the Back Horizon-Glass.

The method of adjusting the quadrant for the back-

Fig. 60.

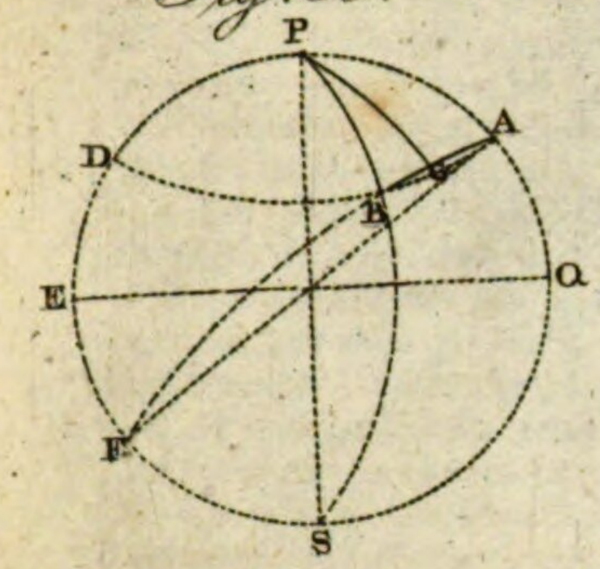


Fig. 61.

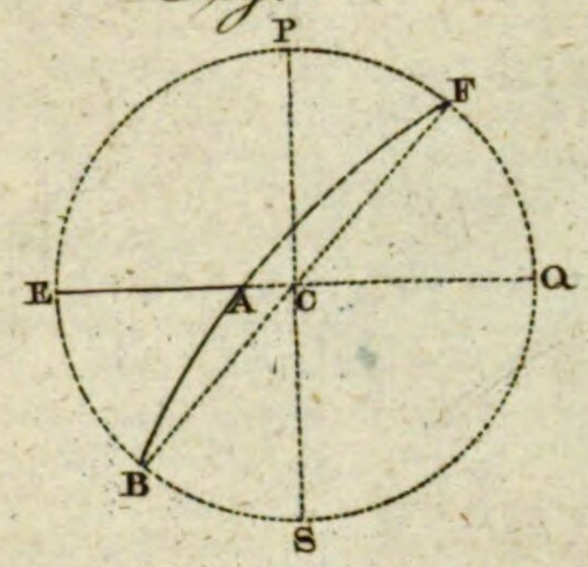


Fig. 62.

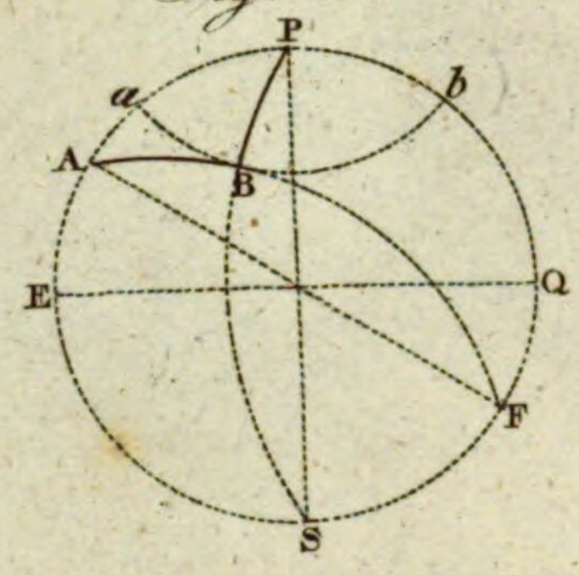


Fig. 63.

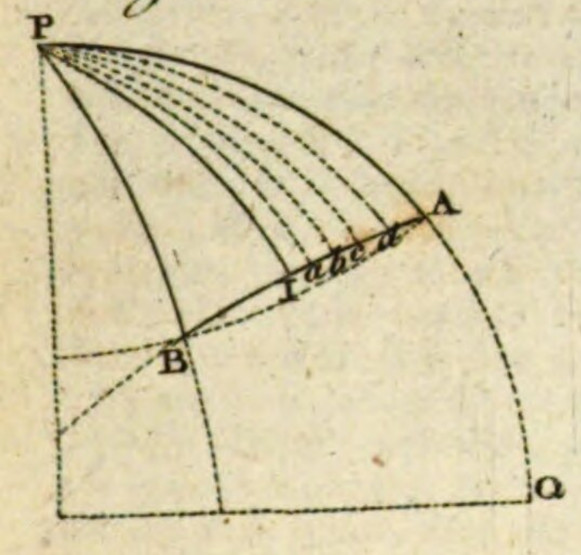


Fig. 65.

Fig. 64.

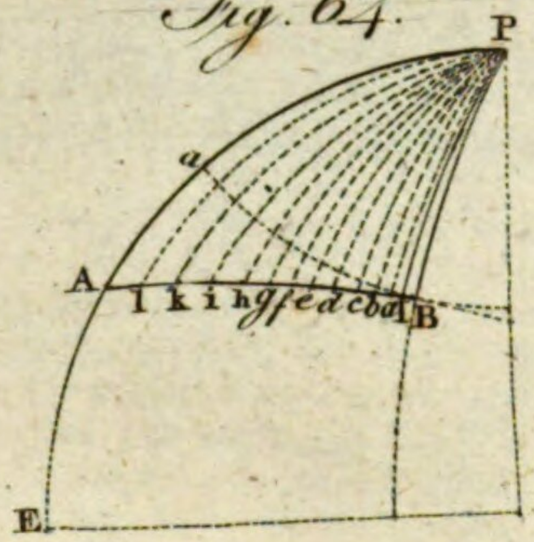


Fig. 66.

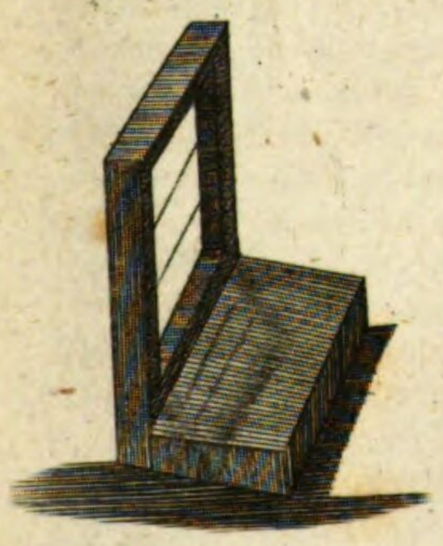
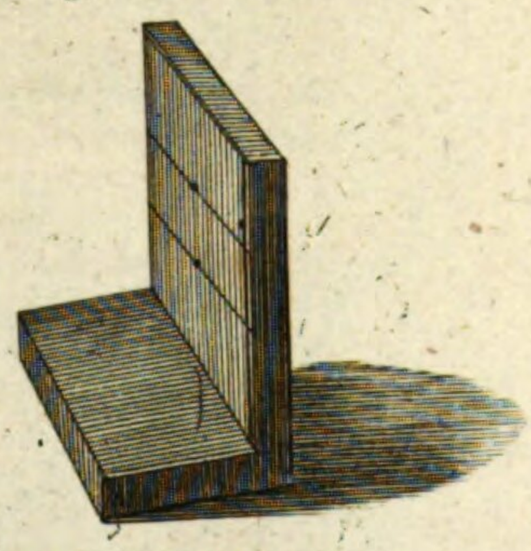


Fig. 67.



A. Bell Prin. Walbr Sculptor fecit.

Method of finding the Latitude and Longitude at Sea.

obſervation is this. If it is to be done without making uſe of the teleſcope, place the index at *o*, and, applying the eye to the hole in the ſight vane (x), or tube for directing the ſight, direct it through the back horizon-glaſs to the horizon, if that is the object to be uſed for adjuſting. The two horizons are then to be made to coincide, holding the quadrant firſt in a vertical and then in an horizontal poſition; by which means both adjuſtments will be effected as in the fore-obſervation.

There will be no difficulty in finding the reflected horizon, if the obſerver firſt directs his eye to that part of the horizon-glaſs where he obſerves the image of the poliſhed edge of the index-glaſs, which will appear double. When the direct horizon is made to appear in this ſpace, the reflected one will be ſeen cloſe by it, unleſs the inſtrument wants a great adjuſtment. In this caſe, a little motion of the back horizon-glaſs backwards and forwards will preſently bring it in view.

When the horizon, or any obſcure terreſtrial object, is to be made uſe of for adjuſting by means of the reflecting edge, there is a precaution to be taken, without which the obſerver will ſometimes meet with what will appear an unaccountable difficulty; for if the ſky, or other object behind him, ſhould happen to be pretty bright, he will not be able to diſcern the horizon at all. This ariſes from the image of the object behind him, which is reflected from the ſilvered ſurface of the index-glaſs, appearing to coincide with the horizon; in which caſe, the bright picture of the former, which is formed in the bottom of the eye, prevents the fainter impreſſion of the latter from being perceived. This will be avoided, either by applying a black ſceeen over the ſilvered ſurface of the index-glaſs, or, without being at this trouble, by ſtanding at a door or window, ſo that only the dark objects within can be reflected from the index-glaſs: but if the obſervation is to be made in the open air, a hat, or any ſuch dark obſtacle, held before the ſilvered ſurface of the index-glaſs, will very effectually remove this inconvenience.

It may be remarked, that ſome obſervers, inſtead of making the principal adjuſtment, place the ſpeculums parallel, by moving the index without altering the poſition of the horizon-glaſs: and the difference between *o* on the vernier and *o* on the limb is the index error, which muſt be ſubtracted from all angles meaſured by the back-obſervation, when *o* on the index is to the right of *o* on the limb; and added when to the left.

3. Mr Wright's method of adjuſting the back horizon-glaſs of his improved patent quadrant.

Plate CCCXLII.

Fig. 69. is a repreſentation of the quadrant complete in all its parts for uſe. A, is the reflecting ſurface of the index-glaſs, which is made of the uſual length, and $\frac{9}{10}$ of an inch broad. The bottom part is covered in front by the braſs frame, and the reflecting ſurface is $\frac{7}{10}$ on the back. B, the fore horizon-glaſs, placed as uſual: O, the back horizon-glaſs, now placed under the fore-ſight vane on the firſt radius of the quadrant I: C, the ſight-vane of the fore horizon-glaſs: D, the ſight-vane of the back horizon-glaſs: E, the coloured glaſſes in a braſs frame, in the proper place for the fore-obſervation: F, a hole in the frame to receive the coloured glaſſes when an obſervation is to be taken with the back horizon-glaſs in the common way, by turning the back to the ſun: G, a hole in the frame of the fartheſt radius K, to receive the coloured glaſſes when an obſervation is to be taken by the new method; which is by looking through the lower hole in the ſight-vane of the back horizon-glaſs, directly at the ſun in the line of ſight DN; the horizon from behind will then be reflected from the back of the index-glaſs to the horizon-glaſs, and from thence to the eye. (See fig. 73.) H, a braſs clamp on the upper end of the index, having a milled ſcrew underneath, which faſtens the round plate to the index when required. (See fig. 70.) IK, the graduated arch of the quadrant divided into 90 degrees: L, the braſs index which moves over the graduated arch: M, the vernier to ſubdivide the diviſions on the arch into ſingle minutes of a degree.

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Fig. 70. ſhows the upper part of the index L on a larger ſcale, with part of the braſs frame that faſtens the index-glaſs, and the three adjuſting ſcrews D to adjuſt its axis vertical to the plane of the quadrant: B, the centre on which the milled plate O moves over the index: The dotted line BF is the diſtance it is required to move: K, the adjuſting ſcrew to ſtop it in its proper place for adjuſting the back obſervation-glaſs: G, a piece of braſs faſtened to the index oppoſite to the clamp H, to keep the plate O always cloſe to the index L.

Fig. 71. repreſents the parallel poſition of the index and horizon-glaſſes after adjuſtment by the ſun: BC, a ray from the ſun incident on the index-glaſs C, and from thence reflected to the fore horizon-glaſs D, and again to the eye at E, in the line DE, where the eye ſees the ſun at A by direct viſion, and the image by reflection in one; the parallel lines AE and BC being ſo near to each other, that no apparent angle can be obſerved in the planes of the index and horizon-glaſs, when adjuſted by a diſtant object.

In fig. 72. the index-glaſs is removed 45 degrees from the plane of the fore horizon-glaſs, and fixed in its proper place for adjuſting the back horizon-glaſs parallel to its plane, in the ſame manner as the fore horizon-glaſs is adjuſted.

In fig. 73. the index-glaſs (after the adjuſtment of the fore and back horizon-glaſſes) is carried forward by the index on the arch 90 degrees, and makes an angle of 45° with the plane of the fore horizon-glaſs, and is at right angles to the plane of the back horizon-glaſs. The eye at E now ſees the ſun in the horizon at H, reflected by the index and horizon-glaſſes from the zenith at Z, the image and object being 90 degrees

(x) Beſides the hole in the ſight vane commonly made, there muſt be another nearer to the horizon-glaſs, and ſo placed that an eye directed through it to the centre of the horizon-glaſs ſhall there perceive the image of the poliſhed edge of the index-glaſs. This hole muſt not be made ſmall like the other, but equal to the ordinary ſize of the pupil of the eye, there being on ſome occaſions no light to ſpare.

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degrees distant. The back horizon K is now reflected from the back surface of the index-glass C to the horizon-glass M, and from thence to the eye at D, in a right line with the fore horizon F. In order to make an exact contact of the fore and back horizons at F, the index must be advanced beyond the 90th degree on the arch, by a quantity equal to twice the dip of the horizon.

The quadrant is adjusted for the fore-observation as usual, having previously fixed the index-glass in its proper place by the milled screw at H, as represented in fig. 70.

To adjust the Quadrant for the Back-observation.

Plate CCCXIII.

Fasten the index to 90° on the limb; loosen the screw H (fig. 70.), and turn the plate O by the milled edge until the end of the adjusting screw K touch the edge of the clamp M; and by means of a distant object observe if the glasses are then parallel, as at fig. 71.: if they are, fasten the screw H; if not, with a screw-driver turn the screw K gently to the right or left to make them perfect, and then fasten the screw. Now remove the index back to O on the limb, and the index-glass will be parallel to the back horizon-glass E, fig. 72.: If not, make them so by turning the adjusting screw of the glass E, the eye being at the upper hole in the sight-vane D, and the sight directed to the horizon, or any distant object in the direction DN (fig. 69.) Now the index remaining in this position, the index-glass is to be returned, to stop at the pin E, and it will be parallel to the fore horizon-glass as at first: then the quadrant will be adjusted for both methods of observation.

To observe the Sun's Altitude by the Back-observation.

Remove the coloured glasses to G (fig. 69.), and look through the lower hole in the sight-vane D, in the line of direction DN, directly to the sun, and move the index forward on the arch exactly in the same manner as in the fore-observation: make the contact of the sun's limb and the back horizon exact, and the degrees and minutes shown by the index on the limb is the sun's zenith distance. It may be observed, that the horizon will be inverted. If the sun's lower limb be observed, the semidiameter is to be subtracted from the zenith distance; but if the upper limb is observed, the semidiameter is to be added.

The observation may be made in the usual manner, by turning the back to the sun. In this case the coloured glasses are to be shifted to F, and proceed according to the directions formerly given.

Use of Hadley's Quadrant.

The altitude of any object is determined by the position of the index on the limb, when by reflection that object appears to be in contact with the horizon.

If the object whose altitude is to be observed be the sun, and if so bright that its image may be seen in the transparent part of the fore horizon-glass, the eye is to be applied to the upper hole in the sight-vane; otherwise, to the lower hole: and in this case, the quadrant is to be held so that the sun may be bisected by the line of separation of the silvered and transparent parts of the glass. The moon is to be kept as nearly as possible in the same position; and the image of the star is to be observed in the silvered part of the glass adjacent to the line of separation of the two parts.

Method of finding the Latitude and Longitude at Sea.

There are two different methods of taking observations with the quadrant. In the first of these the face of the observer is directed towards that part of the horizon immediately under the sun, and is therefore called the *fore observation*. In the other method, the observer's back is to the sun, and it is hence called the *back-observation*. This last method of observation is to be used only when the horizon under the sun is obscured, or rendered indistinct by fog or any other impediment.

In taking the sun's altitude, whether by the fore or back observation, the observer must turn the quadrant about upon the axis of vision, and at the same time turn himself about upon his heel, so as to keep the sun always in that part of the horizon-glass which is at the same distance as the eye from the plane of the quadrant. In this way the reflected sun will describe an arch of a parallel circle round the true sun, whose convex side will be downwards in the fore-observation and upwards in the back; and consequently, when by moving the index, the lowest point of the arch in the fore-observation, or highest in the back, is made to touch the horizon, the quadrant will stand in a vertical plane, and the altitude above the visible horizon will be properly observed. The reason of these operations may be thus explained: The image of the sun being always kept in the axis of vision, the index will always show on the quadrant the distance between the sun and any object seen directly which its image appears to touch; therefore, as long as the index remains unmoved, the image of the sun will describe an arch everywhere equidistant from the sun in the heavens, and consequently a parallel circle about the sun, as a pole. Such a translation of the sun's image can only be produced by the quadrant's being turned about upon a line drawn from the eye to the sun, as an axis. A motion of rotation upon this line may be resolved into two, one upon the axis of vision, and the other upon a line on the quadrant perpendicular to the axis of vision; and consequently a proper combination of these two motions will keep the image of the sun constantly in the axis of vision, and cause both jointly to run over a parallel circle about the sun in the heavens: but when the quadrant is vertical, a line thereon perpendicular to the axis of vision becomes a vertical axis; and as a small motion of the quadrant is all that is wanted, it will never differ much in practice from a vertical axis. The observer is directed to perform two motions rather than the single one equivalent to them on a line drawn from the eye to the sun; because we are not capable, while looking towards the horizon, of judging how to turn the quadrant about upon the elevated line going to the sun as an axis, by any other means than by combining the two motions above mentioned, so as to keep the sun's image always in the proper part of the horizon-glass. When the sun is near the horizon, the line going from the eye to the sun will not be far removed from the axis of vision; and consequently the principal motion of the quadrant will be performed on the axis of vision, and the part of motion made on the vertical axis will be but small. On the contrary, when the sun is near the zenith, the line going to the sun is not far removed from a vertical line, and consequently

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quently the principal motion of the quadrant will be performed on a vertical axis, by the obſerver's turning himſelf about, and the part of the motion made on the axis of viſion will be but ſmall. In intermediate altitudes of the ſun, the motions of the quadrant on the axis of viſion, and on the vertical axis, will be more equally divided.

Obſervations taken with the quadrant are liable to errors, ariſing from the bending and elaſticity of the index, and the reſiſtance it meets with in turning round its centre: whence the extremity of the index, on being puſhed along the arch, will ſenſibly advance before the index-glaſs begins to move, and may be ſeen to recoil when the force acting on it is removed. Mr Hadley ſeems to have been apprehenſive that his inſtrument would be liable to errors from this cauſe; and in order to avoid them, gives particular directions that the index be made broad at the end next the centre, and that the centre, or axis itſelf, have as eaſy a motion as is conſiſtent with ſteadineſs; that is, an entire freedom from looſeneſs, or *ſhake* as the workmen term it. By ſtrictly complying with theſe directions the error queſtion may indeed be greatly diminiſhed; ſo far, perhaps, as to render it nearly inſenſible, where the index is made ſtrong, and the proper medium between the two extremes of a ſhake at the centre on one hand, and too much ſtiffneſs there on the other, is nicely hit; but it cannot be entirely corrected. For to more or leſs of bending the index will always be ſubject; and ſome degree of reſiſtance will remain at the centre, unleſs the friction there could be totally removed, which is impoſſible.

Of the reality of the error to which he is liable from this cauſe, the obſerver, if he is provided with a quadrant furniſhed with a ſcrew for moving the index gradually, may thus ſatisfy himſelf. After finiſhing the obſervation, lay the quadrant on a table, and note the angle; then cautiouſly looſen the ſcrew which faſtens the index, and it will immediately, if the quadrant is not remarkably well conſtructed, be ſeen to ſtart from its former ſituation, more or leſs according to the perfection of the joint and the ſtrength of the index. This ſtarting, which is owing to the index recoiling after being releaſed from the confined ſtate it was in during the obſervation, will ſometimes amount to ſeveral minutes; and its direction will be oppoſite to that in which the index was moved by the ſcrew at the time of finiſhing the obſervation. But how far it affects the truth of the obſervation, depends on the manner in which the index was moved in ſetting it to *o*, for adjuſting the inſtrument; or in finiſhing the obſervations neceſſary for finding the index error.

The eaſieſt and beſt rule to avoid theſe errors ſeems to be this: In all obſervations made by Hadley's quadrant, let the obſerver take notice conſtantly to finiſh his obſervations, by moving the index in the ſame direction which was uſed in ſetting it to *o* for adjuſting; or in the obſervations neceſſary for finding the index error. If this rule is obſerved, the error ariſing from the ſpring of the index will be obviated. For as the index was bent the ſame way, and in the ſame degree in adjuſting as in obſerving, the truth of the obſervations will not be affected by this bending.

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To take Altitudes by the Fore-obſervation.

I. *Of the Sun.*

Turn down either of the coloured glaſſes before the horizon-glaſs, according to the brightneſs of the ſun; direct the ſight to that part of the horizon which is under the ſun, and move the index until the coloured image of the ſun appears in the horizon-glaſs; then give the quadrant a ſlow vibratory motion about the axis of viſion; move the index until the lower or upper limb of the ſun is in contact with the horizon, at the loweſt part of the arch deſcribed by this motion; and the degrees and minutes ſhown by the index on the limb will be the altitude of the ſun.

II. *Of the Moon.*

Put the index to *o*, turn down the green glaſs, place the eye at the lower hole in the ſight-vane, and obſerve the moon in the ſilvered part of the horizon-glaſs; move the index gradually, and follow the moon's reflected image until the enlightened limb is in contact with the horizon, at the lower part of the arch deſcribed by the vibratory motion as before, and the index will ſhow the altitude of the obſerved limb of the moon. If the obſervation is made in the daytime, the coloured glaſs is unneceſſary.

III. *Of a Star or Planet.*

The index being put to *o*, direct the ſight to the ſtar through the lower hole in the ſight-vane and tranſparent part of the horizon-glaſs; move the plane of the quadrant a very little to the left, and the image of the ſtar will be ſeen in the ſilvered part of the glaſs. Now move the index, and the image of the ſtar will appear to deſcend; continue moving the index gradually until the ſtar is in contact with the horizon at the loweſt part of the arch deſcribed; and the degrees and minutes ſhown by the index on the limb will be the altitude of the ſtar.

To take Altitudes by the Back-obſervation.

I. *Of the Sun.*

Put the ſtem of the coloured glaſſes into the perforation between the horizon-glaſſes, turn down either according to the brightneſs of the ſun, and hold the quadrant vertically; then direct the ſight through the hole in the back ſight vane, and the tranſparent ſlit in the horizon-glaſs to that part of the horizon which is oppoſite to the ſun; now move the index till the ſun is in the ſilvered part of the glaſs, and by giving the quadrant a vibratory motion, the axis of which is that of viſion, the image of the ſun will deſcribe an arch whoſe convex ſide is upwards; bring the limb of the ſun, when in the upper part of this arch, in contact with the horizon; and the index will ſhow the altitude of the other limb of the ſun.

II. *Of the Moon.*

The altitude of the moon is obſerved in the ſame manner as that of the ſun, with this difference only, that the uſe of the coloured glaſs is unneceſſary unleſs the moon is very bright; and that the enlightened limb, whether

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whether it be the upper or lower, is to be brought in contact with the horizon.

III. *Of a Star or Planet.*

Look directly to the ſtar through the vane and tranſparent ſlit in the horizon-glaſs, move the index until the oppoſite horizon, with reſpect to the ſtar, is ſeen in the ſilvered part of the glaſs; and make the contact perfect as formerly. If the altitude of the ſtar is known nearly, the index may be ſet to that altitude, the ſight directed to the oppoſite horizon, and the obſervation made as before.

Sect. II. *Of finding the Latitude of a Place.*

The obſervation neceſſary for aſcertaining the latitude of a place, is that of the meridional altitude of a known celeſtial object; or two altitudes when the object is out of the meridian. The latitude is deduced with more certainty and with leſs trouble from the firſt of theſe methods, than from the ſecond; and the ſun, for various reaſons, is the object moſt proper for this purpoſe at ſea It, however, frequently happens, that by the interpoſition of clouds, the ſun is obſcured at noon; and by this means the meridian altitude is loſt. In this caſe, therefore, the method by double altitudes becomes neceſſary. The latitude may be deduced from three altitudes of an unknown object, or from double altitudes, the apparent times of obſervation being given.

The altitude of the limb of an object obſerved at ſea, requires four ſeparate corrections in order to obtain the true altitude of its centre: theſe are for *ſemidiameter*, *dip*, *refraction*, and *parallax*. (See Astronomy, and the reſpective articles). The firſt and laſt of theſe corrections vaniſh when the obſerved object is a fixed ſtar.

When the altitude of the lower limb of any object is obſerved, its ſemidiameter is to be added thereto in order to obtain the central altitude; but if the upper limb be obſerved, the ſemidiameter is to be ſubtracted. If the altitude be taken by the back-obſervation, the contrary rule is to be applied. The dip is to be ſubtracted from, or added to, the obſerved altitude, according as the fore or back-obſervation is uſed. The refraction is always to be ſubtracted from, and the parallax added to, the obſerved altitude.

Prob. I. To reduce the ſun's declination to any given meridian.

Rule. Find the number in Table IX. anſwering to the longitude in the table neareſt to that given, and to the neareſt day of the month. Now, if the longitude is weſt, and the declination increaſing, that is, from the 20th of March to the 22d of June, and from the 22d of September to the 22d of December, the above number is to be added to the declination: during the other part of the year, or while the declination is decreaſing, this number is to be ſubtracted. In eaſt longitude, the contrary rule is to be applied.

Example I. Required the ſun's declination at noon 15th April 1793, in longitude 84° W?

Sun's declination at noon at Greenwich	10° 1′.8	N
Number from Table IX. -	+ 5.0	
Reduced declination - -	10 6.8	N

Example II. Required the ſun's declination at noon 22d March 1793, in longitude 151° E? Method of finding the Latitude and Longitude at Sea.

Sun's declination at noon at Greenwich	0° 56′	N
Equation from table - -	— 10	
Reduced declination -	0 46	N

Prob. II. Given the ſun's meridian altitude, to find the latitude of the place of obſervation.

Rule. The ſun's ſemidiameter is to be added to, or ſubtracted from, the obſerved altitude, according as the lower or upper limb is obſerved; the dip anſwering to the height from Table V. is to be ſubtracted if the fore-obſervation is uſed; otherwiſe, it is to be added; and the refraction anſwering to the altitude from Table IV. is to be ſubtracted: hence the true altitude of the ſun's centre will be obtained. Call the altitude ſouth or north, according as the ſun is ſouth or north at the time of obſervation; which ſubtracted from 90°, will give the zenith diſtance of a contrary denomination.

Reduce the ſun's declination to the meridian of the place of obſervation, by Problem I.; then the ſum or difference of the zenith diſtance and declination, according as they are of the ſame or of a contrary denomination, will be the latitude of the place of obſervation, of the ſame name with the greater quantity.

Example I. October 17th 1792, in longitude 32° E, the meridian altitude of the ſun's lower limb was 48° 53′ S, height of the eye 18 feet. Required the latitude?

Obs. alt. ſun's lower limb	48° 53′ S	Sun's dec. 17. Oct. noon.	9° 37′ S
Semidiameter	+0 16	Equation Table IX.	— 2
Dip and refraction	—0 5	Reduced declination	9 35 S
True alt. ſun's centre	49 4 S	Zenith diſtance	40 56 N
		Latitude	31 21 N

Example II. November 16th 1793, in longitude 158° W, the meridian altitude of the ſun's lower limb was 87° 37′ N, height of the eye 10 feet. Required the latitude?

Obs. alt. ſun's low. limb	87° 37′ N.	Sun's dec. noon.	18° 57′ S
Semidiameter	+0 16	Equation table	+0 8
Dip and refract.	— 0 3	Reduced dec.	19 5 S
True alt. ſun's centre	87 50 N.	Zenith diſtance	2 10 S
		Latitude	21 15 S

Example III. December 19th 1793, being nearly under the meridian of Greenwich, the altitude of the ſun's upper limb at noon was 4° 30′ S, height of the eye 20 feet. Required the latitude?

Obſerved altitude of the ſun's upper limb		4° 30′	S
Sun's ſemidiameter - -	—	0 16	
Dip and refraction -	—	0 15	
True altitude of the ſun's centre -		3 59	S
Zenith diſtance - -		86 1	N
Declination - -		23 27	S
Latitude - - -		62 34	N

Example

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EXAMPLE IV. Auguſt 23d 1793, in longitude 107 E, the meridian altitude of the ſun's lower limb by the back-obſervation was 61° 8′ N, and the height of the eye 14 feet. Required the latitude?

Obſerved altitude ſun's upper limb -	61° 8′ N
Sun's ſemidiameter - -	—0 16
Dip - -	+0 3½
Refraction - -	—0 ½
True altitude of ſun's centre -	60 55 N
Zenith diſtance - -	29 5 S
Reduced declination - -	11 20 N
Latitude - - -	17 45 S

The dip in Table V. anſwers to an entirely open and unobſtructed horizon. It, however, frequently happens, that the ſun is over the land at the time of obſervation, and the ſhip nearer to the land than the viſible horizon would be if unconfined. In this caſe, the dip will be different from what it would otherwiſe have been, and is to be taken from Table VI. in which the height is expreſſed at the top, and the diſtance from the land in the ſide column in nautical miles.—Seamen, in general, can eſtimate the diſtance of any object from the ſhip with ſufficient exactneſs for this purpoſe, eſpecially when that diſtance is not greater than ſix miles, which is the greateſt diſtance of the viſible horizon from an obſerver on the deck of any ſhip.

PROB. III. Given the meridian altitude of a fixed ſtar, to find the latitude of the place of obſervation.

RULE. Correct the altitude of the ſtar by dip and refraction, and find the zenith diſtance of the ſtar as formerly; take the declination of the ſtar from Table XI. and reduce it to the time of obſervation. Now, the ſum or difference of the zenith diſtance and declination of the ſtar, according as they are of the ſame or of a contrary name, will be the latitude of the place of obſervation.

EXAMPLE I. December 1ſt 1793, the meridian altitude of Sirius was 59° 50′ S, height of the eye 14 feet. Required the latitude?

Obſerved altitude of Sirius -	59° 50′ S
Dip and refraction - -	—0 4
True altitude - -	59 46 S
Zenith diſtance - -	30 14 N
Declination - -	16 27 S
Latitude - -	13 47 N

EXAMPLE II. February 17th 1797, the meridian altitude of Procyon was 71° 15′ N, the height of the eye 10 feet. Required the latitude?

Obſerved altitude of Procyon -	71° 15′ N
Dip and refraction - -	—0 3
True altitude - -	71 12 N
Zenith diſtance - -	18 48 S
Declination - -	5 45 N
Latitude - - -	13 3 S

PROB. IV. Given the meridian altitude of a planet, to find the latitude of the place of obſervation.

RULE. Compute the true altitude of the planet as directed in laſt problem (which is ſufficiently accurate for altitudes taken at ſea); take its declination from the Nautical Almanac, page iv. of the month, and reduce it to the time and meridian of the place of obſervation; then the ſum or difference of the zenith diſtance and declination of the planet will be the latitude as before.

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EXAMPLE I. December 10th 1792, the meridian altitude of Saturn was 68° 42′ N, and height of the eye 15 feet. Required the latitude?

Obſerved altitude of Saturn -	68° 42′ N
Dip and refraction - -	—0 4
True altitude - - -	68 38 N
Zenith diſtance - -	21 22 S
Declination - - -	7 26 N
Latitude - - -	13 56 S

EXAMPLE II. April 16th 1793, the meridian altitude of Jupiter was 81° 5′ S, height of the eye 18 feet. Required the latitude?

Obſerved altitude of Jupiter - -	81° 5′ S
Dip - - -	—0 3
True altitude - -	81 2 S
Zenith diſtance - - -	8 58 N
Declination - - -	19 4 S
Latitude - - -	10 6 S

PROB. V. Given the meridian altitude of the moon, to find the latitude of the place of obſervation.

RULE. Take the number † anſwering to the ſhip's longitude, and daily variation of the moon's paſſing the meridian; which being applied to the time of paſſage given in the Nautical Almanac, will give the time of the moon's paſſage over the meridian of the ſhip.

† *Mackay's Treatiſe on the Longitude*, Tab. XX.

Reduce this time to the meridian of Greenwich; and by means of the Nautical Almanac find the moon's declination, horizontal parallax, and ſemidiameter, at the reduced time.

Apply the ſemidiameter and dip to the obſerved altitude of the limb, and the apparent altitude of the moon's centre will be obtained; to which add the correction anſwering to the apparent altitude and horizontal parallax ‡, and the ſum will be the true altitude of the moon's centre; which ſubtracted from 90°, the remainder is the zenith diſtance, and the ſum or difference of the zenith diſtance and declination, according as they are of the ſame or of a contrary name, will be the latitude of the place of obſervation.

‡ Ditto, Tab. XX.

EXAMPLE I. December 24th 1792, in longitude 30° W, the meridian altitude of the moon's lower limb was 81° 15′ N, height of the eye 12 feet. Required the latitude?

Time of paſſ. over the mer. of Greenwich =	9h 19′
Equation Table XX. - -	+0 4
Time of paſſ. over mer. ſhip - -	9 23
Longitude in time - -	2 0
Reduced time - - -	11 23
Moon's dec. at midnight, Tab. IX.	=14° 53′ N
Eq. to time from midnight -	—0 4
Reduced declination - -	14 49 N
Moon's hor. par. - -	55′ 25″

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Moon's ſemidiameter	- -	15 6
Augmentation	- -	+0 14
Aug. ſemidiameter	- -	15 20
Obſerved altitude of the moon's lower limb		81° 15′ N
Semidiameter	- -	+0 15
Dip	- - -	−0 3
Apparent altitude of the moon's centre		81 27 N
Correction	- -	+0 8
True altitude of moon's centre,		81 35 N
Zenith diſtance	- -	8 25 S
Declination	- - -	14 49 N
Latitude	- -	6 42 N

Example II. October 17th 1793, in longitude 8° W, the altitude of the moon's upper limb was 40° 27′ S, and height of the eye 20 feet. Required the latitude?

Time of paſſ. over mer. Greenwich		= 10h 52′
Equation to long.	- -	0 0
Time of paſſ. over mer. ſhip	-	10 52
Longitude in time	- -	0 32
Reduced time	- -	11 24
Moon's dec. at midnight	-	=0° 3′ N
Eq. to time from midnight	-	−0 3
Reduced declination	- -	0 0
Moon's hor. parallax	- -	60′ 29″
Moon's ſemidiameter	- -	16 29
Augmentation	- -	+0 12
Aug. ſemidiameter	- -	16 41
Obſerved altitude moon's lower limb	-	40° 27′ S
Semidiameter and dip	- -	−0 21
Apparent altitude moon's centre	-	40 6
Correction	- -	+0 45
True altitude moon's centre	-	40 51 S
Zenith diſtance	- -	49 9 N
Declination	- -	0 0
Latitude	- - -	49 9 N

Remark. If the object be on the meridian below the pole at the time of obſervation, then the ſum of the true altitude and the complement of the declination is the latitude, of the ſame name as the declination or altitude.

Example I. July 1ſt 1793, in longitude 15° W, the altitude of the ſun's lower limb at midnight was 8° 58′, height of the eye 18 feet. Required the latitude?

Obſerved altitude ſun's lower limb	-	8° 58′
Semidiameter	- -	+0 16
Dip and refraction	- -	−0 10
True altitude of ſun's centre	-	9 4 N
Compl. declin. reduced to time and place		66 57 N
Latitude	- - -	76 1 N

Example II. December 1ſt 1798, the altitude of the pole ſtar below the pole was 52° 20 N, height of the eye 12 feet. Required the latitude?

Obſerved altitude, pole ſtar	-	52° 20′ N.
Dip and refraction	- -	−0 4
True altitude	- -	52 16 N.
Complement of declination	-	1 46
Latitude	- -	54 2 N.

Prob. VI. Given the latitude by account, the declination and two obſerved altitudes of the ſun, and the interval of time between them, to find the true latitude.

Rule. To the log. ſecant of the latitude by account, add the log. ſecant of the ſun's declination; the ſum, rejecting 20 from the index, is the *logarithm ratio*. To this add the log. of the difference of the natural ſines of the two altitudes, and the log. of the half elapſed time from its proper column.

Find this ſum in column of middle time, and take out the time anſwering thereto; the difference between which and the half elapſed time will be the time from noon when the greater altitude was obſerved.

Take the log. anſwering to this time from column of riſing, from which ſubtract the log. ratio, the remainder is the logarithm of a natural number; which being added to the natural ſine of the greater altitude, the ſum is the natural coſine of the meridian zenith diſtance; from which and the ſun's declination the latitude is obtained as formerly.

If the latitude thus found differs conſiderably from that by account, the operation is to be repeated, uſing the computed latitude in place of that by account (l).

Example I. June 4th 1795, in latitude by account

(l) This method is only an approximation, and ought to be uſed under certain reſtrictions; namely,

The obſervations muſt be taken between nine o'clock in the forenoon and three in the afternoon. If both obſervations be in the forenoon, or both in the afternoon, the interval muſt not be leſs than the diſtance of the time of obſervation of the greateſt altitude from noon. If one obſervation be in the forenoon and the other in the afternoon, the interval muſt not exceed four hours and an half; and in all caſes, the nearer the greater altitude is to noon the better.

If the ſun's meridian zenith diſtance be leſs than the latitude, the limitations are ſtill more contracted. If the latitude be double the meridian zenith diſtance, the obſervations muſt be taken between half paſt nine in the morning and half paſt two in the afternoon, and the interval muſt not exceed three hours and an half. The obſervations muſt be taken ſtill nearer to noon, if the latitude exceeds the zenith diſtance in a greater proportion. See *Maſkelyne's Britiſh Mariner's Guide, and Requiſite Tables*, 2d Ed.

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count 37° N at 10h 29′ A. M. *per* watch, the corrected altitude of the sun was 65° 24′, and at 12h 31′, the altitude was 74° 8′. Required the true latitude?

Times *per* wat. Alt. N. Sines. Lat. by acc. 37° 0′ Secant 0.09765
10h 29′ 65° 24′ 90924 Declination 22 28 Secant 0.03428

12 31	74 8	96190	Logarithm ratio		0.13193
2 2	Differ.	5266	Logarithm		3.72148
1 1			Half elapsed time		0.57999
31 10″			Middle time -		4.43340
29 50			Rising - -		2.92740
			Log. ratio		0.13193
Natural number		-	624		2.79547
Greatest altitude	74° 8′ N. sine		96190		
Mer. zenith dist.	14 30 N. cosine		96814		
Declination	22 28				
Latitude	36 58 N.				

EXAMPLE II. October 17th 1793, in latitude 43° 24′ N. by account, at 0h 38′ P. M. the correct altitude of the sun's centre was 36° 5′, and at 2h 46′ P. M. the altitude was 24° 49′. Required the latitude?

Times *per* wat. Alt. N. Sines. Lat. by acc. 43° 24′ Secant 0.13872
0h 38′ 36° 5′ 58896 Declination 9 32 Secant 0.00604

2 46	24 49	41972	Logarithm ratio		0.14476
2 8	Differ.	16924	Log.		4.22850
1 4			Half elapsed time		0.55966
1 41 30″			Middle time		4.93292
37 30			Rising		3.12570
			Log. ratio		0.14476
Natural number			957		2.98094
Greatest altitude	36° 5′ N. sine		58896		
Mer. zen. distance	53 14 N. cosine		59853		
Declination	9 32				
Latitude	43 42 N.				

EXAMPLE III. August 25th 1793, in latitude 57° N. by account, in the morning the altitude of the sun's lower limb was 34° 22′, and 1h 46′ after the altitude of the lower limb was 42° 12½′, the height of the eye 14 feet. Required the latitude?

First altitude	34° 22′	Second altitude	42° 12½′
Sun's semidiameter	+0 16	Semidiameter	+0 16
Dip and refraction	—0 5	Dip and refract.	—0 4½
Corrected altitude	34 33	Corrected altit.	42 24

Interval of time. Altit. 34° 33′ N. Sines. 56713 Lat. by acc. 57° 0′ Secant. 0.26389 Declination 10 33 Secant. 0.00741

42 24	67430	Logarithm ratio			0.27130
1h 46′	Difference 10717		Log.		4.03007
53 0″		Half elapsed time			0.63978
1 43 30		Middle time			4.94115
50 30		Rising			3.38343
			Log. ratio		0.27130
Natural number			1295		3.11213
Greatest altitude	42° 24′ N. sine		67430		
Mer. zen. distance	46 35 N. cosine		68725		
Declination	10 33				
Latitude	57 8 N.				

The greatest altitude was observed 50′½ before 12 or at 11h 9′½; hence the first altitude was observed at 9h 23′½ A. M.

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EXAMPLE IV. In latitude 49° 48′ N. by account, the sun's declination being 9° 37′ S. at 0h 32′ P. M. *per* watch, the altitude of the sun's lower limb was 28° 32′, and at 2h 41′ it was 19° 25′, the height of the eye 12 feet. Required the true latitude?

First observed altit.	28° 32′	Second altitude	19° 25′
Semidiameter	+0 16	Semidiameter	+0 16
Dip and refraction	—0 5	Dip and refr.	—0 6
True altitude	28 43	True altitude	19 35

Time *per* wat. Alt. N. Sines. Lat. by acc. 49° 48′ Secant. 0.19013
0h 32′ 28° 43′ 48048 Declination 9 37 Secant 0.00615

2 41	19 35	33518	Log. ratio - -		0.09628
2 9	Difference 14530		Log. -		4.16227
1 4 30″			Half elapsed time		0.55637
1 37 0			Middle time		4.91492
32 30			Rising		3.00164
Natural number			639		2.80536
Mer. zen. dist.	60° 52′ N. cosine		48687		
Declination	9 37 S.				
Latitude	51 15 N.				

As the latitude by computation differs 1° 27′ from that by account, the operation must be repeated.

Computed latitude	51° 15′	Secant		0.20348
Declination	9 37	Secant		0.00615
Logarithm ratio - -				0.20963
Difference of nat. sines	14530	Log.		4.16227
Half elapsed time	1h 4′ 30″	Log.		0.55637
Middle time	1 40 20	Log.		4.92827
Rising -	0 35 50	Log.		3.08630
Natural number		753		2.87667
Gr. altitude	28° 43′ N. sine	48048		
Mer. zen. dist.	60 47 N. cosine	48801		
Declination	9 37			
Latitude	51 10 N.			

As this latitude differs only 5′ from that used in the computation, it may therefore be depended on as the true latitude.

PROB. VII. Given the latitude by account, the sun's declination, two observed altitudes, the elapsed time, and the course and distance run between the observations; to find the ship's latitude at the time of observation of the greater altitude.

RULE. Find the angle contained between the ship's course and the sun's bearing at the time of observation of the least altitude, with which enter the Traverse Table as a course, and the difference of latitude answering to the distance made good will be the reduction of altitude.

Now, if the least altitude be observed in the forenoon, the reduction of altitude is to be applied thereto by addition or subtraction, according as the angle between

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between the ship's course and the sun's bearing is less or more than eight points. If the least altitude be observed in the afternoon, the contrary rule is to be used.

The difference of longitude in time between the observations is to be applied to the elapsed time by addition or subtraction, according as it is east or west. This is, however, in many cases so inconsiderable as to be neglected.

With the corrected altitudes and interval, the latitude by account and sun's declination at the time of observation of the greatest altitude, the computation is to be performed by the last problem.

EXAMPLE I. July 6th 1793, in latitude 58° 14′ N. by account, and longitude 16° E. at 10h 54′ A. M. *per* watch, the altitude of the sun's lower limb was 53° 17′, and at 1h 17′ P. M. the altitude was 52° 51′, and bearing *per* compass SW*b*W; the ship's course during the elapsed time was S*b*W½W, and the hourly rate of sailing 8 knots, the height of the eye 16 feet. Required the true latitude at the time of observation of the greater altitude?

Sun's bear. at 2d. ob. SW*b*W. Interval bet. observ. 2h 23′
Ship's course S*b*W½W Dist. run = 2h 23 × 8 = 19m.

Contained angle 3½ points.

Now to course 3½ points and distance 19 miles, the difference of latitude is 14.7 or 15 miles.

First observed alt.	53° 17′	Second observed alt.	52° 51′
Semidiameter	+0 16	Semidiameter	+0 16
Dip and refract.	—0 4	Dip and refraction	—0 4
True altitude	53 29	Reduction	—0 15
		Reduced altitude	52 48

Time of ob. of gr. alt. 10h 54′ A. M. Sun's dec. 22° 39′ N.
Longitude in time 1 4 Eq. to r. t. + 1

Reduced time 9 50 A. M. Red. decl. 22 40 N.

Time *per* wat. Alt. N. Sines. Lat. by acc. 58° 14′ Secant. 0.27863
10h 54′ 53° 29′ 80368 Declination 22 40 Secant. 0.03491

1 17	52 48	79653	Logarithm ratio		0.31354
2 23	Difference	715	Log.		2.85431
1 11	30″		Half elapsed time		0.51294
5 30			Middle time		3.68079
1 6	0		Rising		3.61469
			Log. ratio		0.31354
Natural number				2001	3.30115
Greatest altitude	53° 29′	N. sine		80368	
Mer. zen. distance	34 33	N	cosine	82369	
Declination	22 40	N.			
Latitude	57 13	N.			

Since the computed latitude differs so much from that by account, it will be necessary to repeat the operation.

Computed latitude	57° 13′	Secant	0.26643
Declination	22 40	Secant	0.03491
Logarithm ratio			0.30134

Difference of natural sines		715	Log. 2.85431
Half elapsed time	1h 11′ 30″		Log. 0.51294
Middle time	5 20		Log. 3.66859
Rising -	1 6 10		Log. 3.61686
Logarithm ratio			- 0.30134
Natural number		2068	3.31552
Greatest altitude	53° 29′ N.	sine	80368
Mer. zen. dist.	34 29	N. cosine	82436
Declination	22 40	N.	
Latitude	57 9	N.	

As this latitude differs only 4 miles from that used in the computation, it may therefore be depended on as the true latitude.

EXAMPLE II. Sept. 13th 1793, in latitude 38° 12′ N by account, and longitude 14° E. at 9h 28′ A. M. *per* watch, the altitude of the sun's lower limb was 40° 42′, and azimuth *per* compass SE¼E, at 11h 16′ A. M. the altitude was 53° 11′; the ship's course during the elapsed time was W½N at the rate of 9 knots an hour, and height of the eye 12 feet. Required the ship's true latitude at the time of the second observation?

Sun's bear. at first obs. SE.¼E. Elapsed time 1h. 48′
Ship's course, W½N. D. run = 1h 48′ × 9 = 16m

Contained angle 11¾ points; supplement 4¼ pts.

To course 4¼ points, and distance run 16 miles, the difference of latitude is 10′.7, or 11 miles.

First observed alt.	40° 42′	Second obs. alt.	53° 11
Sun's semidiameter	+0 16′	Semidiameter	+0 16
Dip and refraction	—0 4	Dip and refr.	—0 4
Reduction of alt.	—0 11	Corrected alt.	53 23
Reduced altitude,	40 43		
Time of ob. great. alt.	11h 16′	Sun's dec. at noon	3 32½
Longitude in time,	0 56	Eq. to time from n.	+ 1½
Reduced time,	10 20	Reduced declin.	3 34

Time *per* Watch. Alt. N. Sine Lat. by acc 38° 12′ Secant 0.10466
9h 28′ 40° 43′ 65232 Declination 3 34 Secant 0.00084

11 16	53 23	80264	Logarithm ratio	-	0.10550
1 48	Differ.	15032	Log.	- -	4.17702
0 54			Half elapsed time	-	0.63181
1 37			Middle time	-	4.91333
0 43			Rising	- -	3.24427
Natural number				1376	3.13877
Mer. Zen. dist.	35° 16′	N. cosine		81640	
Declination	3 34				Secant 0.00084
Latitude	38 50				Secant 0.10848
Logarithm ratio	-		-		0.10932
Difference of natural sines			15032		Log. 4.17702
Half elapsed time			oh 54′ 0″		Log. 0.63181
Middle time	-		1 37 50		Log. 4.91815
Rising	- -		0 43 10		Log. 3.26089
Natural number	-	-	1418		3.15157

Greatest

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Greateſt altitude	53° 23′ N.	ſine	80264
Mer. Zen. diſt.	35 14 N.	coſine	81682
Declination	3 34		
Latitude -	38 48 N.		

This latitude differing only 2 miles from that uſed in the computation, may therefore be relied on as the true latitude.

Remark. If the ſun comes very near the zenith, the ſines of the altitude will vary ſo little as to make it uncertain which ought to be taken as that belonging to the natural ſine of the meridian altitude. In this caſe, the following method will be found preferable.

To the log. riſing of the time from noon found as before, add the log. ſecant of half the ſum of the eſtimate meridian altitude, and greateſt obſerved altitude; from which ſubtract the log. ratio, its index being increaſed by 10, and the remainder will be the log. ſine of an arch; which added to the greateſt altitude will give the ſun's meridian altitude.

Example. December 21ſt 1793, in latitude 22° 40′ S; by account, at 11h 57′ the correct altitude of the ſun's centre was 89° 10′, and at 12h 4′ 40″, the altitude was 88° 50′. Required the true latitude?

Times *per* Wat. A t. N. Sines. Lat. by acc. 22° 40′ Sec. 0.03491
11h 57′ 0″ 89° 10′ 99989 Declination 23 28 Sec. 0.03749

12	4	40	88 50	99979	Logarithm ratio	0.07240
0	7	10	Difference 10		log.	1.00000
0	3	50	Half elapſed time			1.77663
0	0	50	Middle time			2.84903
0	3	0	Riſing			0.93284

Comp. of lat. by acc.	67° 20′		
Declination	23 28		
Sum	90 48		
Eſtimate mer. altitude	89 12	89° 11′	ſec. 11.84609
Greateſt altitude	89 10		
			12.77893
Logarithm ratio + 5			5.07240
Arch	0 17′	ſine	7.70653
Greateſt altitude	89 10		
Meridian altitude	89 27	zen. diſt.	0 33′ N
		declination	23 28 S
		latitude	22 55 S

This differing from the aſſumed latitude, the work muſt be repeated.

Latitude	22° 55′	ſecant	0.03571
Declination	23 28	ſecant	0.03749
Logarithm ratio			0.07320
Difference of natural ſines,	1°	log.	1.00000
Half elapſed time	3′ 50″		1.77663
Middle time	0 50		2.84983
Riſing	3 0		0.93284
mp. of lat.	67° 5′		
Declination	23 28		
Sum	90 33		

Mer. alt.	89 27	89° 18′½	ſec. 11.91827
Greateſt alt.	89 10		
			12.85111
Log. ratio + 5			5.07320
Arch	0 21		7.77791
Greateſt altitude	89 10		
Merid. altitude	89 31	zen. diſt.	0° 29′
		Declination	23 28
		Latitude	22 59 S

If the work be repeated with this laſt latitude, the latter part only may be altered.

Latitude	22° 59′	ſecant	0.03592
Declination	23 28	ſecant	0.03749
Eſt. mer. alt.	89 31	log. ratio	0.07341
Greateſt altitude	89 10	ar. com. — 5	4.92659
Sum	178 41		
Half	89 20½	ſecant	1.93972
Riſing			0.93284
Arch	0 22	fine	7.79915
Greateſt altitude	89 10		
Meridian altitude	89 32		
Zenith diſtance	0 28		
Declination	23 28		
Latitude	23 0 S.		

Prob. VIII. To find the latitude from double altitudes of the ſun and the elapſed time; one of theſe obſervations being taken near the eaſt or weſt points, and the other near the meridian.

Rule. With the latitude by account, the ſun's declination and leaſt altitude, compute the apparent time of obſervation by Problem VII. of next chapter. From whence and the interval of time between the obſervations, the time from noon when the greateſt altitude was obſerved will be known. To the logarithm riſing of which, add the logarithmic coſines of the ſun's declination and the latitude of the place by account; the ſum will be the logarithm of a natural number, which added to the natural ſine of the greater altitude, will give the natural coſine of the meridian zenith diſtance; and hence the latitude is found as formerly.

Or the time from noon being found, the latitude may be computed by the rule given in the preceding remark.

Example. September 1ſt 1793, in latitude 40° 0′ N. by account, at 6h 5′ A. M. per watch, the altitude of the ſun's lower limb was 16° 21′, and at 11h 41′ the altitude was 57° 42′; the height of the eye 18 feet. Required the latitude?

Firſt alt.	16° 21′	Second alt.	57° 42′
Sun's ſemidia.	+0 16	Sun's ſemidia.	+0 16
Dip and refr.	—0 7	Dip and refrac.	—0 5
True altitude	16 30	True altitude	57 53

Lat.

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Lat. by acc.	40 0 N	Secant		0.11575
Declination	8 3 N	Secant		0.00430
Difference	31 57	nat. cosine	84851	
Altitude	16 30	nat. sine	28402	
		Difference	56449	4.75165
Time from noon of first obs.	5h 0′ 40″	rising		4.87170
Interval of time between obs.	4 45 0			
Time from noon of 2d obs.	0 15 40	rising		2.36839
Latitude by acc.	40° 0′	cosine		9.88425
Declination	8 3	cosine		9.99670
Natural number		178		2.24934
Greater altitude	57 53	nat. sine	84697	
Merid. zen. dist.	31 55	nat. cosine	84875	
Declination	8 3			
Latitude	39 58 N.			

PROB. IX. Given the altitudes of two known ſtars, obſerved at the ſame or at different times; and if at different times, the interval between the obſervations; to find the latitude.

Rule. If both altitudes be obſerved at the ſame time, call the difference between their right aſcenſions the reduced interval.

But if the altitudes be taken at different times, reduce the interval between the obſervations to ſidereal time, by adding thereto the proportional part anſwering to the interval, and 3′ 56″, the daily acceleration of the fixed ſtars. Now to the right aſcenſion of the firſt obſerved ſtar, add the interval in ſidereal time, and the difference between this ſum and the right aſcenſion of the other ſtar will be the reduced interval.

To the logarithm riſing of the reduced interval, add the logarithmic coſines of the ſtars declinations; ſubtract the natural number anſwering to the ſum of theſe logarithms from the natural coſine of the difference or ſum of the ſtars declinations, according as they are of the ſame or of a contrary name, and the remainder will be the natural ſine of arch firſt.

To the logarithmic coſine of arch firſt add the logarithmic ſecant of declination of the ſtar having the leaſt polar diſtance, and the logarithm half elapſed time of the reduced interval, the ſum will be the logarithm half elapſed time of arch ſecond.

From the natural coſine of the difference between arch firſt and the altitude of the ſtar having the greateſt polar diſtance, ſubtract the natural ſine of the altitude of the other ſtar, and find the logarithm of the remainder; to which add the logarithm ſecant of arch firſt, and the logarithmic ſecant of the altitude of the ſtar having the greateſt polar diſtance, the ſum will be the logarithm riſing of arch third. The difference between arches ſecond and third is arch fourth.

To the logarithm riſing of arch fourth add the logarithmic coſines of the declination and altitude of the ſtar having the greateſt polar diſtance; ſubtract the correſponding natural number from the natural coſine of the difference between the altitude and declination, the polar diſtance being leſs than 90°; otherwiſe, from their ſum, and the remainder will be the natural ſine of the latitude.

EXAMPLE I. January 1ſt 793, the true altitude of Capella was 69° 23′, and at the ſame inſtant the true altitude of Sirius was 16° 19′. Required the latitude?

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Right aſcenſion of Capella	5h 1′ 25″			
Right aſcenſion of Sirius	6 36 1			
Interval	1 34 36			
Interval	1h 34′ 36″	rising		3.92270
Capella's declin.	45 46 N	cosine		9.84160
Sirius's declin.	16 27 S	cosine		9.98185
Sum	62 13 N	cosine	46613	
			5599	3.74815
Arch firſt	24 13 N	sine	41014	cos. 9.96000
Capella's declin.	45 46	secant		0.15640
Interval	1h 34′ 36″	H. E. time		0.39670
Arch ſecond	1 11 28	H. E. time		0.51310
Arch firſt	24 13	secant		0.04000
Sirius's altitude	16 19	secant		0.01785
Difference	7 54 N.	cosine	99051	
Capella's altitude	69 23 N	sine	93596	
			5455	3.73679
Arch third	1h 21′ 20″	rising		3.79464
Arch ſecond	1 11 28			
Arch fourth	9 52	rising		1.96708
Sirius's declin.	16 27	cosine		9.98185
altitude	16 19	cosine		9.98215
Sum	32 46 N	cos.	84088	
			85	1.93008
Latitude	57 9 N	sine	84003	

EXAMPLE II. In north latitude, Decem. 30th 1793, the true altitude of Menkar was 43° 38′; and 1h 18′ after the altitude of Rigel was 29° 51′. Required the latitude?

Obſerved Interval	1h 18′ 0″			
Equation	+ 0 0 13			
Inter. in ſid. time	1 18 13			
Right aſ. of Menkar	2 51 31			
Sum	4 9 44			
Right aſc. of Rigel	5 4 34			
Reduced interval	0 54 50	riſing		3.45462
Declin. of Menkar	3 16½ N	cosine		9.99929
Declin. of Rigel	8 27 S	cosine		9.99526
Sum	11 43½ N	co.	97913	
			2813	3.44917
Arch firſt	71 59 N	sine	95100	co. 9.49037
Declin. of Menkar	3 16½	secant		0.00071
Reduced interval	0 54 50	H. E. time		0.62529
Arch ſecond	3 19 36	H. E. time		0.11637

Fig. 68.

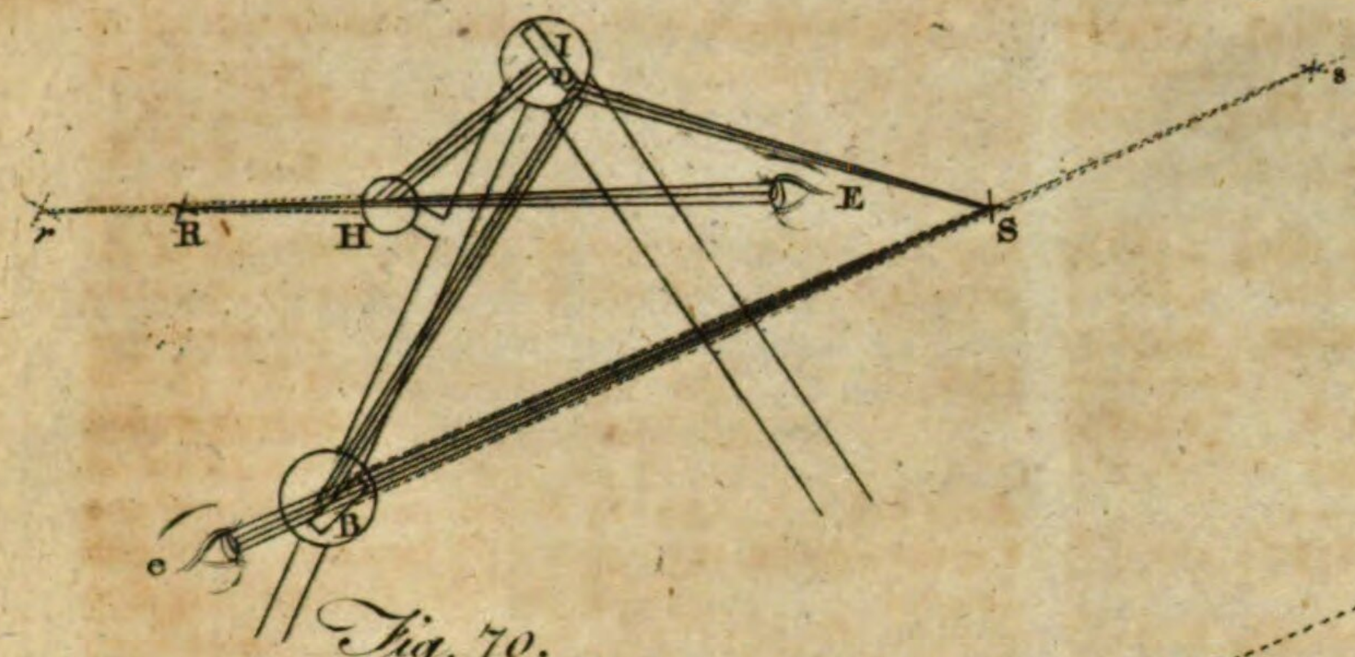


Fig. 69.

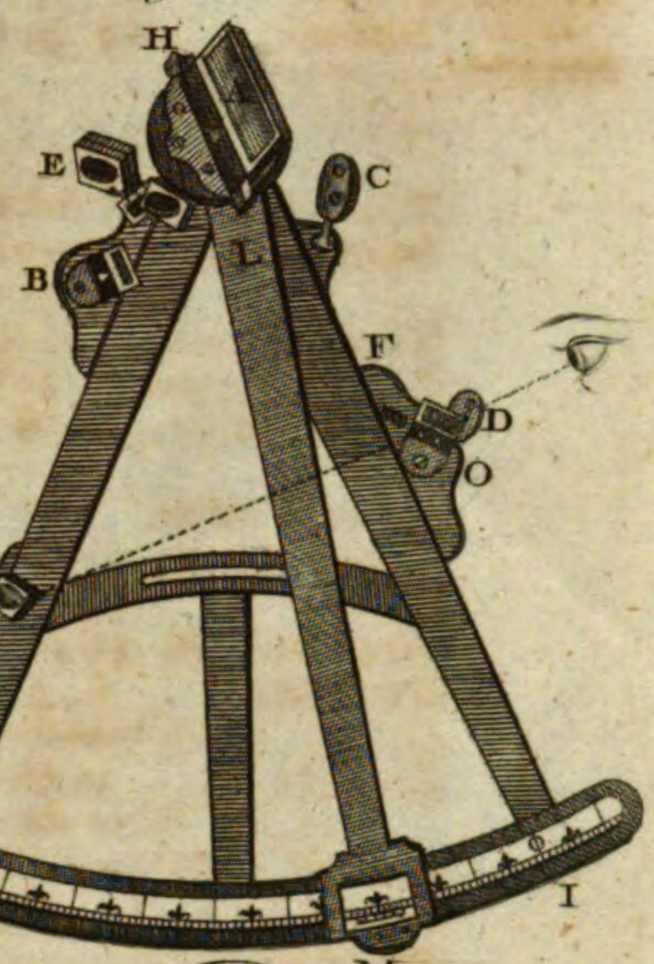


Fig. 70.

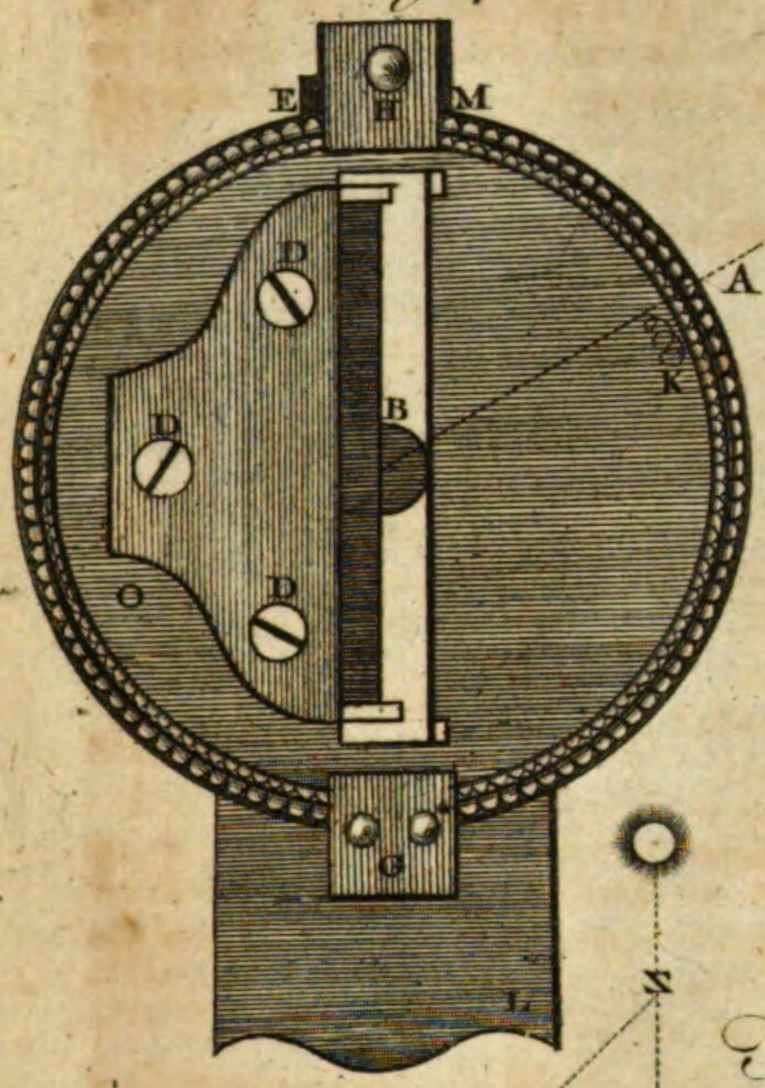


Fig. 71.

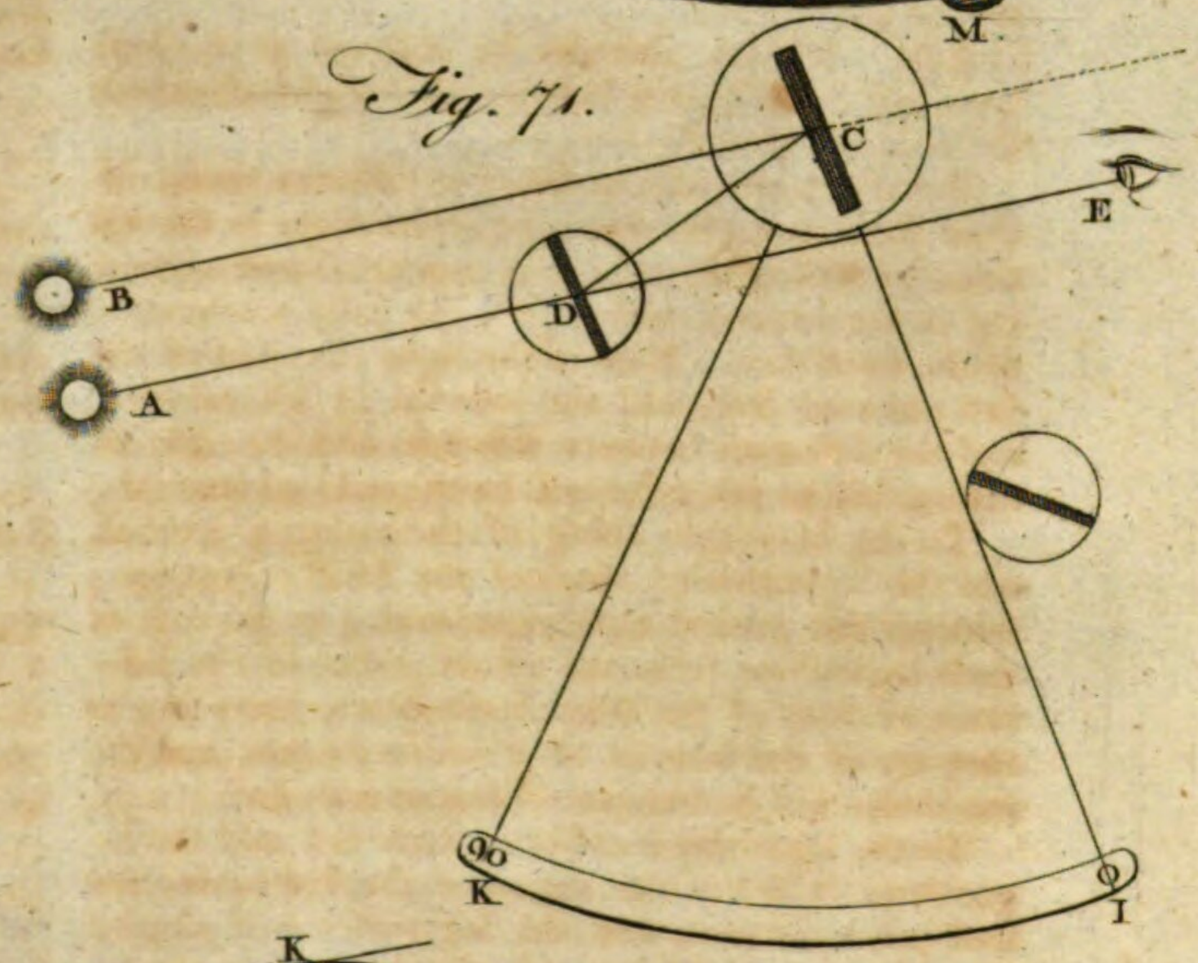


Fig. 73.

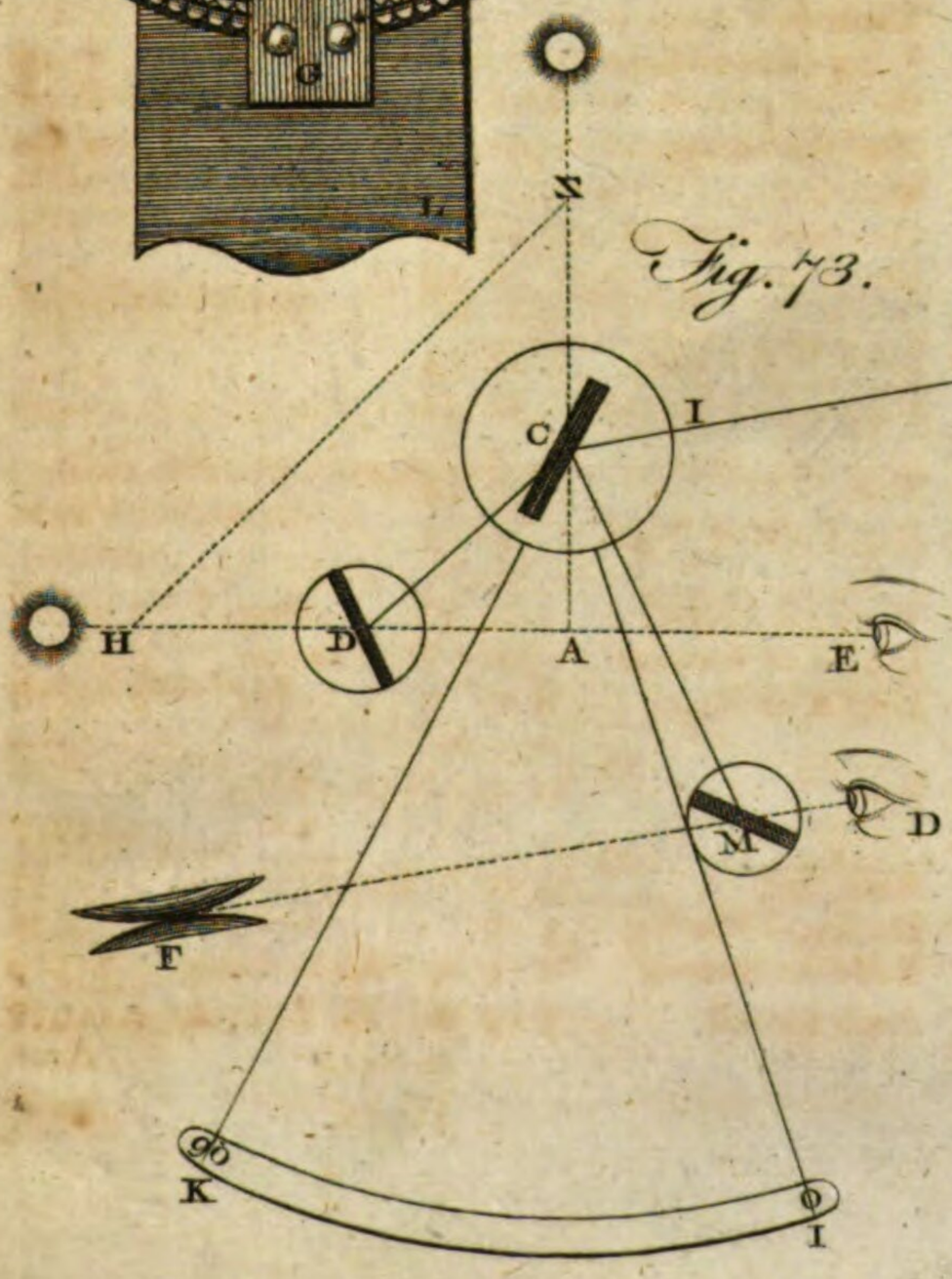
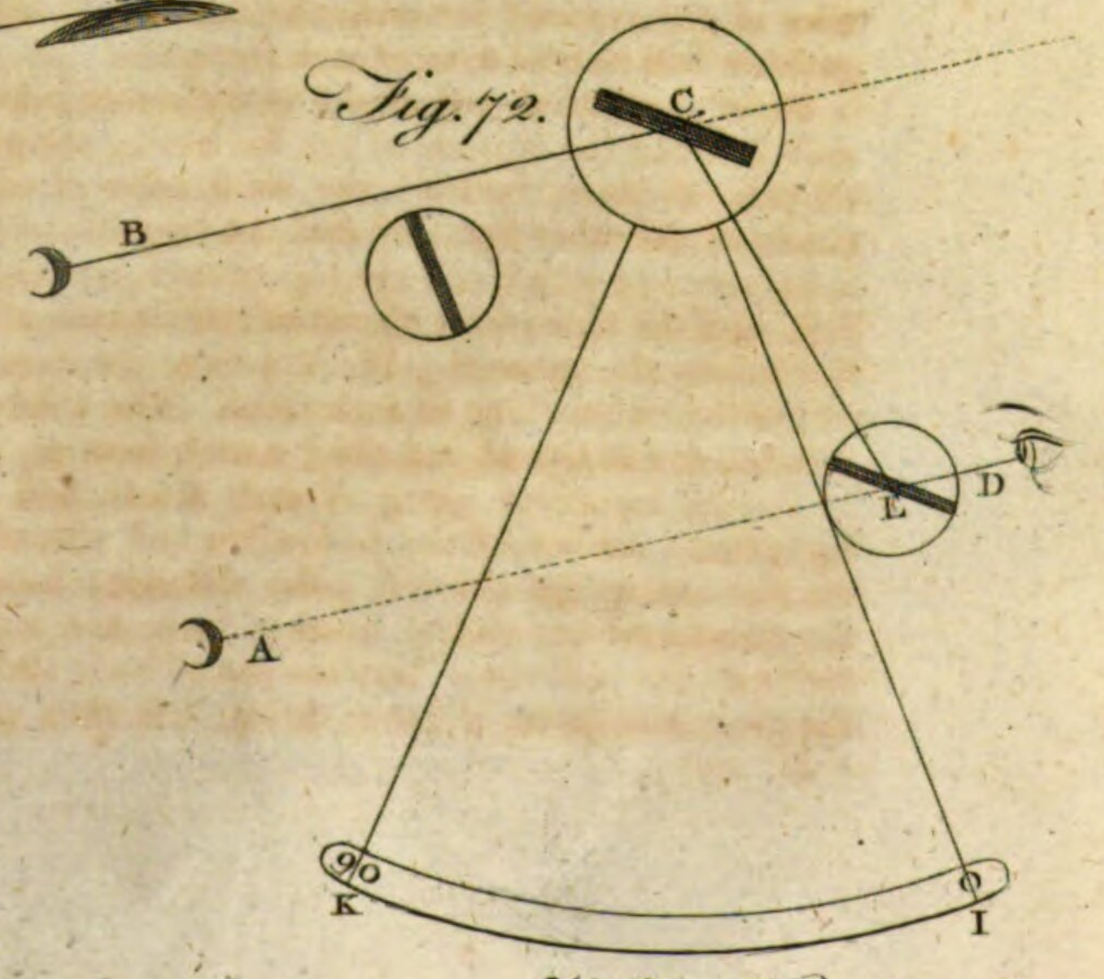


Fig. 72.



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Arch firſt	71°59′	ſecant	0.50963
Altitude Rigel	29 51	ſecant	0.06181
Difference	42 8 N	coſine	74159
Alt. of Menkar	43 38 N	ſine	69004
		Difference 5155	3.71223
Arch third	2h 24′ 27″	riſing	4.28367
Arch ſecond	3 19 36		
Arch fourth	0 55 9	riſing	3.45960
Declin. of Rigel	8 27 S	coſine	9.99526
Alt. of Rigel	29 51	coſine	9.93819
Sum	38 18 N	coſine	78478
			2472 3.39305
Latitude	49 28 N	ſine	76006

CHAP. II. *Containing the Method of finding the Longitude at Sea by Lunar Obſervations.*

SECT. I. *Introduction.*

THE obſervations neceſſary to determine the longitude by this method are, the diſtance between the ſun and moon, or the moon and a fixed ſtar near the ecliptic, together with the altitude of each. The ſtars uſed in the Nautical Almanac for this purpoſe are the following: namely, α *Arietis*, *Aldebaran*, *Pollux*, *Regulus*, *Spica Virginis*, *Antares*, α *Aquilæ*, *Fomalhaut*, and α *Pegaſi*; and the diſtances of the moon's centre from the ſun, and from one or more of theſe ſtars, are contained in the viii. ix. x. and xi. pages of the month, at the beginning of every third hour apparent time, by the meridian of Greenwich. The diſtance between the moon and the ſun, or one of theſe ſtars, is obſerved with a ſextant; and the altitudes of the objects are taken as uſual with a Hadley's quadrant.

In the practice of this method, it will be found convenient to be provided with three aſſiſtants; two of theſe are to take the altitudes of the ſun and moon, or moon and ſtar, at the ſame time the principal obſerver is taking the diſtance between the objects; and the third aſſiſtant is to obſerve the time, and write down the obſervations. In order to obtain accuracy, it will be neceſſary to obſerve ſeveral diſtances, and the correſponding altitudes; the intervals of time between them being as ſhort as poſſible; and the ſum of each divided by the number will give the mean diſtance and mean altitudes; from which the time of obſervation at Greenwich is to be computed by the rules to be explained.

If the ſun or ſtar from which the moon's diſtance is obſerved be at a proper diſtance from the meridian, the time at the ſhip may be inferred from the altitude obſerved at the ſame time with the diſtance: in this caſe, the watch is not neceſſary; but if that object be near the meridian, the watch is abſolutely neceſſary, in order to connect the obſervations for aſcertaining the apparent time at the ſhip and the longitude with each other.

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An obſerver without any aſſiſtants may very eaſily take all the obſervations, by firſt taking the altitudes of the objects, then the diſtance, and again their altitudes, and reduce the altitudes to the time of obſervation of the diſtance; or, by a ſingle obſervation of the diſtance, the apparent time being known, the longitude may be determined.

A ſet of obſervations of the diſtance between the moon and a ſtar, and their altitudes, may be taken with accuracy during the time of the evening or morning twilight; and the obſerver, though not much acquainted with the ſtars, will not find it difficult to diſtinguiſh the ſtar from which the moon's diſtance is to be obſerved. For the time of obſervation nearly, and the ſhip's longitude by account being known, the eſtimate time at Greenwich may be found; and by entering the Nautical Almanac with the reduced time, the diſtance between the moon and given ſtar will be found nearly. Now ſet the index of the ſextant to this diſtance, and hold the plane of the inſtrument ſo as to be nearly at right angles to the line joining the moon's cuſps, direct the ſight to the moon, and by giving the ſextant a ſlow vibratory motion, the axis of which being that of viſion, the ſtar, which is uſually one of the brighteſt in that part of the heavens, will be ſeen in the ſilvered part of the horizon-glaſs.

SECT. II. *Of the Sextant.*

THIS inſtrument is conſtructed for the expreſs purpoſe of meaſuring with accuracy the angular diſtance between the ſun and moon, or between the moon and a fixed ſtar, in order to aſcertain the longitude of a place by lunar obſervations. It is, therefore, made with more care than the quadrant, and has ſome additional appendages that are wanting in that inſtrument.

Fig. 74. repreſents the ſextant, ſo framed as not to be liable to bend (M). The arch AA is divided into 120 degrees, each degree is divided into three parts; each of theſe parts, therefore, contains 20 minutes, which are again ſubdivided by the vernier into every half minute or 30 ſeconds. The vernier is numbered at every fifth of the longer diviſions, from the right towards the left, with 5, 10, 15, and 20; the firſt diviſion to the right being the beginning of the ſcale. Plate CCCXLIII.

In order to obſerve with accuarcy, and make the images come preciſely in contact, an adjuſting ſcrew B is added to the index, which may thereby be moved with greater accuracy than it can be by hand; but this ſcrew does not act until the index is fixed by the finger ſcrew C. Care ſhould be taken not to force the adjuſting ſcrew when it arrives at either extremity of its adjuſtment. When the index is to be moved any conſiderable quantity, the ſcrew C at the back of the ſextant muſt be looſened; but when the index is brought nearly to the diviſion required, this back ſcrew ſhould be tightened, and then the index may be moved gradually by the adjuſting ſcrew.

(M) Troughton's patent double-framed ſextants are not liable to bend.

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There are four tinged glaſſes D, each of which is ſet in a ſeparate frame that turns on a centre. They are uſed to defend the eye from the brightneſs of the ſolar image and the glare of the moon, and may be uſed ſeparately or together as occaſion requires.

There are three more ſuch glaſſes placed behind the horizon-glaſs at E, to weaken the rays of the ſun or moon when they are viewed directly through the horizon-glaſs. The paler glaſs is ſometimes uſed in obſerving altitudes at ſea, to take off the ſtrong glare of the horizon.

The frame of the index-glaſs I is firmly fixed by a ſtrong cock to the centre plate of the index. The horizon-glaſs F is fixed in a frame that turns on the axes or pivots, which move in an exterior frame; the holes in which the pivots move may be tightened by four ſcrews in the exterior frame. G is a ſcrew by which the horizon glaſs may be ſet perpendicular to the plane of the inſtrument: ſhould this ſcrew become looſe or move too eaſy, it may be eaſily tightened by turning the capſtan-headed ſcrew H, which is on one ſide of the ſocket through which the ſtern of the finger ſcrew paſſes.

Plate CCCXLIII.

The ſextant is furniſhed with a plain tube (fig. 75.) without any glaſſes; and to render the objects ſtill more diſtinct, it has two teleſcopes, one (fig. 76.) repreſenting the objects erect, or in their natural poſition: the longer one (fig. 77.) ſhows them inverted; it has a large field of view and other advantages, and a little uſe will ſoon accuſtom the obſerver to the inverted poſition, and the inſtrument will be as readily managed by it as by the plain tube alone. By a teleſcope the contact of the images is more perfectly diſtinguiſhed; and by the place of the images in the field of the teleſcope, it is eaſy to perceive whether the ſextant is held in the proper place for obſervation. By ſliding the tube that contains the eye-glaſſes in the inſide of the other tube, the object is ſuited to different eyes, and made to appear perfectly diſtinct and well defined.

The teleſcopes are to be ſcrewed into a circular ring at K; this ring reſts on two points againſt an exterior ring, and is held thereto by two ſcrews; by turning one or other of theſe ſcrews, and tightening the other, the axis of the teleſcope may be ſet parallel to the plane of the ſextant. The exterior ring is fixed on a triangular braſs ſtem that ſlides in a ſocket, and by means of a ſcrew at the back of the quadrant may be raiſed or lowered ſo as to move the centre of the teleſcope to point to that part of the horizon-glaſs which ſhall be judged the moſt fit for obſervation. Fig. 78. is a circular head, with tinged glaſſes to ſcrew on the eye-end of either of the teleſcopes or the plain tube. The glaſſes are contained in a circular plate which has four holes; three of theſe are fitted with tinged glaſſes, the fourth is open. By preſſing the finger againſt the projecting edge of this plate, and turning it round, the open hole, or any of the tinged glaſſes, may be brought between the eye-glaſs of the teleſcope and the eye.

Fig. 79. is a magnifying glaſs, to aſſiſt the obſerver to read off the angle with more accuracy; and (fig. 80.) a ſcrew-driver.

Adjuſtments of the Sextant.

The adjuſtments of a ſextant are, to ſet the mirrors perpendicular to its plane and parallel to each other when the index is at Zeno, and to ſet the axis of the teleſcope parallel to the plane of the inſtrument. The three firſt of theſe adjuſtments are performed nearly in the ſame manner as directed in the ſection on the quadrant: as, however, the ſextant is provided with a ſet of coloured glaſſes placed behind the horizon-glaſs, the index error may be more accurately determined by meaſuring the ſun's diameter twice, with the index placed alternately before and behind the beginning of the diviſions: half the difference of theſe two meaſures will be the index-error, which muſt be added to, or ſubtracted from, all obſervations, according as the diameter meaſured with the index to the left of *o* is leſs or greater than the diameter meaſured with the index to the right of the beginning of the diviſions.

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Adjuſtment IV. *To ſet the Axis of the Teleſcope parallel to the Plane of the Inſtrument.*

Turn the eye end of the teleſcope until the two wires are parallel to the plane of the inſtrument; and let two diſtant objects be ſelected, as two ſtars of the firſt magnitude, whoſe diſtance is not leſs than 90° or 100°; make the contact of theſe objects as perfect as poſſible at the wire neareſt the plane of the inſtrument; fix the index in this poſition; move the ſextant till the objects are ſeen at the other wire, and if the ſame points are in contact, the axis of the teleſcope is parallel to the plane of the ſextant; but if the objects are apparently ſeparated, or do partly cover each other, correct half the error by the ſcrews in the circular part of the ſupporter, one of which is above and the other between the teleſcope and ſextant; turn the adjuſting ſcrew at the end of the index till the limbs are in contact; then bring the objects to the wire next the inſtrument; and if the limbs are in contact, the axis of the teleſcope is adjuſted; if not, proceeed as at the other wire, and continue till no error remains.

It is ſometimes neceſſary to know the angular diſtance between the wires of the teleſcope: to find which, place the wires perpendicular to the plane of the ſextant, hold the inſtrument vertical, direct the ſight to the horizon, and move the ſextant in its own plane till the horizon and upper wire coincide; keep the ſextant in this poſition, and move the index till the reflected horizon is covered by the lower wire; and the diviſion ſhown by the index on the limb, corrected by the index error, will be the angular diſtance between the wires. Other and better methods will readily occur to the obſerver at land.

Uſe of the Sextant.

When the diſtance between the moon and the ſun or a ſtar is to be obſerved, the ſextant muſt be held ſo that its plane may paſs through the eye of the obſerver and both objects; and the reflected image of the moſt luminous of the two is to be brought in contact with the other ſeen directly. To effect this, therefore, it is evident, that when the brighteſt object is to the right of the other, the face of the ſextant muſt be held upwards; but if to the left, downwards. When the face of the ſextant is held upwards, the inſtrument ſhould be ſupported with the right hand, and the index moved with the left hand. But when the face of the ſextant is from the obſerver, it ſhould be held with

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the left hand, and the motion of the index regulated by the right hand.

Sometimes a ſitting poſture will be found very convenient for the obſerver, particularly when the reflected object is to the right of the direct one: in this caſe, the inſtrument is ſupported by the right hand, the elbow may reſt on the right knee, the right leg at the ſame time reſting on the left knee.

If the ſextant is provided with a ball and ſocket, and a ſtaff, one of whoſe ends is attached thereto, and the other reſts in a belt faſtened round the body of the obſerver, the greater part of the weight of the inſtrument will by this means be ſupported by his body.

To obſerve the Diſtance between the Moon and any celeſtial Object.

1. Between the ſun and moon.

Put the teleſcope in its place, and the wires parallel to the plane of the inſtrument; and if the ſun is very bright, raiſe the plate before the ſilvered part of the ſpeculum; direct the teleſcope to the tranſparent part of the horizon-glaſs, or to the line of ſeparation of the ſilvered and tranſparent parts according to the brightneſs of the ſun, and turn down one of the coloured glaſſes; then hold the ſextant ſo that its plane produced may paſs through the ſun and moon, having its face either upwards or downwards according as the ſun is to the right or left of the moon; direct the ſight through the teleſcope to the moon, and move the index till the limb of the ſun is nearly in contact with the enlightened limb of the moon; now faſten the index, and by a gentle motion of the inſtrument make the image of the ſun move alternately paſt the moon; and, when in that poſition where the limbs are neareſt each other, make the coincidence of the limbs perfect by means of the adjuſting ſcrew: this being effected, read off the degrees and parts of a degree ſhown by the index on the limb, uſing the magnifying glaſs; and thus the angular diſtance between the neareſt limbs of the ſun and moon is obtained.

2. Between the moon and a ſtar.

Direct the middle of the field of the teleſcope to the line of ſeparation of the ſilvered and tranſparent parts of the horizon-glaſs; if the moon is very bright, turn down the lighteſt coloured glaſs, and hold the ſextant ſo that its plane may be parallel to that paſſing through the eye of the obſerver and both objects; its face being upwards if the moon is to the right of the ſtar, but if to the left, the face is to be held from the obſerver; now direct the ſight through the teleſcope to the ſtar, and move the index till the moon appears by reflection to be nearly in contact with the ſtar; faſten the index, and turn the adjuſting ſcrew till the coincidence of the ſtar and enlightened limb of the moon is perfect: and the degrees and parts of a degree ſhown by the index will be the obſerved diſtance between the moon's enlightened limb and the ſtar.

The contact of the limbs muſt always be obſerved in the middle between the parallel wires.

It is ſometimes difficult for thoſe not much accuſtomed to obſervations of this kind, to find the reflected image in the horizon-glaſs: it will perhaps in this caſe be found more convenient to look directly to the object, and, by moving the index, to make its image coincide with that ſeen directly.

Sect. III. *Of the Circular Inſtrument of Reflection.*

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This inſtrument was propoſed with a view to correct the errors to which the ſextant is liable; particularly the error ariſing from the inaccuracy of the diviſions on the limb. It conſiſts of the following parts; a circular ring or limb, two moveable indices, two mirrors, a teleſcope, coloured glaſſes, &c.

The limb of this inſtrument is a complete circle of metal, and is connected with a perforated central plate by ſix radii: it is divided into 720 degrees; each degree is divided into three equal parts; and the diviſion is carried to minutes by means of the index ſcale as uſual.

The two indices are moveable about the ſame axis, which paſſes exactly through the centre of the inſtrument:—the firſt index carries the central mirror, and the other the teleſcope and horizon-glaſs; each index being provided with an adjuſting ſcrew for regulating its motion, and a ſcale for ſhowing the diviſions on the limb.

The central mirror is placed on the firſt index immediately above the centre of the inſtrument, and its plane makes an angle of about 30° with the middle line of the index. The four ſcrews in its pedeſtal for making its plane perpendicular to that of the inſtrument have ſquare heads, and are therefore eaſily turned either way by a key for that purpoſe.

The horizon-glaſs is placed on the ſecond index near the limb, ſo that as few as poſſible may be intercepted of the rays proceeding from the reflected object when to the left. The perpendicular poſition of this glaſs is rectified in the ſame manner as that of the horizon-glaſs of a ſextant, to which it is ſimilar. It has another motion, whereby its plane may be diſpoſed ſo as to make a proper angle with the axis of the teleſcope, and a line joining its centre, and that of the central mirror.

The teleſcope is attached to the other end of the index. It is an achromatic aſtronomical one, and therefore inverts objects; it has two parallel wires in the common focus of the glaſſes, whoſe angular diſtance is between two and three degrees; and which, at the time of obſervation, muſt be placed parallel to the plane of the inſtrument. This is eaſily done, by making the mark on the eye-piece coincide with that on the tube. The teleſcope is moveable by two ſcrews in a vertical direction with regard to the plane of the inſtrument, but is not capable of receiving a lateral motion.

There are two ſets of coloured glaſſes, each ſet containing four, and differing in ſhade from each other. The glaſſes of the larger ſet, which belongs to the central mirror, ſhould have each about half the degree of ſhade with which the correſpondent glaſs of the ſet belonging to the horizon mirror is tinged. Theſe glaſſes are kept tight in their places by ſmall preſſing ſcrews, and make an angle of about 85° with the plane of the inſtrument; by which means the image from the coloured glaſs is not reflected to the teleſcope. When the angle to be meaſured is between 5° and 34°, one of the glaſſes of the largeſt ſet is to be placed before the horizon-glaſs.

The handle is of wood, and is ſcrewed to the back of the inſtrument, immediately under the centre, with which it is to be held at the time of obſervation.

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Plate CCCXLIII.

Fig. 81. is a plan of the inſtrument, wherein the limb is repreſented by the divided circular plate; A is the central mirror, *a a*, the places which receive the ſtems *a a* of the glaſs fig. 84; EF, the firſt or central index, with its ſcale and adjuſting ſcrew; MN, the ſecond or horizon index; GH, the teleſcope; IK, the ſcrews for moving it towards or from the plane of the inſtrument; C, the place of the coloured glaſs fig. 83; and D, its place in certain obſervations.

Fig. 82. is a ſection of the inſtrument, wherein the ſeveral parts are referred to by the ſame letters as in fig. 81: Fig. 83. repreſents one of the horizon coloured glaſſes; and fig. 84. one of the central coloured glaſſes: Fig. 85. is the key for turning the adjuſting ſcrews of the mirrors: Fig. 86. is the handle: Fig. 87. a ſection of one of the radii towards its middle: Fig. 88. is uſed in ſome terreſtrial obſervations for diminiſhing the light of the direct object, whoſe place at the time of obſervation is D: Fig. 89. is the tool for adjuſting the central mirror, and for rectifying the poſition of the teleſcope with regard to the plane of the inſtrument; there is another tool exactly of the ſame ſize. The height of theſe is nearly equal to that of the middle of the central mirror.

Adjuſtments of the Circular Inſtrument.

I. *To ſet the horizon-glaſs ſo that none of the rays from the central mirror ſhall be reflected to the teleſcope from the horizon mirror, without paſſing through the coloured glaſs belonging to this laſt mirror.*—Place the coloured glaſs before the horizon mirror; direct the teleſcope to the ſilvered part of that mirror, and make it nearly parallel to the plane of the inſtrument; move the firſt index; and if the rays from the central mirror to the horizon glaſs, and from thence to the teleſcope, have all the ſame degree of ſhade with that of the coloured glaſs uſed, the horizon-glaſs is in its proper poſition; otherwiſe the pedeſtal of the glaſs muſt be turned until the uncoloured images diſappear.

II. Place the two adjuſting tools on the limb, about 350° of the inſtrument diſtant, one on each ſide of the diviſion on the left, anſwering to the plane of the central mirror produced: then the eye being placed at the upper edge of the neareſt tool, move the central index till one half only of the reflected image of this tool is ſeen in the central mirror towards the left, and move the other tool till its half to the right is hid by the ſame edge of the mirror; then, if the upper edges of both tools are apparently in the ſame ſtraight line, the central mirror is perpendicular to the plane of the inſtrument; if not, bring them into this poſition by the ſcrews in the pedeſtal of the mirror.

III. *To ſet the horizon mirror perpendicular to the plane of the inſtrument.*—The central mirror being previouſly adjuſted, direct the ſight through the teleſcope to any well defined diſtant object; then if, by moving the central index, the reflected image paſſes exactly over the direct object the mirror is perpendicular; if not, its poſition muſt be rectified by means of the ſcrews in the pedeſtal of the glaſs.

A planet, or ſtar of the firſt magnitude, will be found a very proper object for this purpoſe.

IV. *To make the line of collimation parallel to the plane of the inſtrument.*—Lay the inſtrument horizontally on a table; place the two adjuſting tools on the limb, towards the extremities of one of the diameters of the inſtrument; and at about 15 or 20 feet diſtant let a well defined mark be placed, ſo as to be in the ſame ſtraight line with the tops of the tools; then raiſe or lower the teleſcope till the plane paſſing through its axis and the tops of the tools is parallel to the plane of the inſtrument, and direct it to the fixed object; turn either or both of the ſcrews of the teleſcope till the mark is apparently in the middle between the wires; then is the teleſcope adjuſted; and the difference, if any, between the diviſions pointed out by the indices of the ſcrews will be the error of the indices. Hence this adjuſtment may in future be eaſily made.

In this proceſs the eye tube muſt be ſo placed as to obtain diſtinct viſion.

V. *To find that diviſion to which the ſecond index being placed the mirrors will be parallel, the central index being at Zero.*—Having placed the firſt index exactly to *o*, direct the teleſcope to the horizon mirror, ſo that its field may be biſected by the line of ſeparation of the ſilvered and tranſparent parts of that mirror; hold the inſtrument vertically, and move the ſecond index until the direct and reflected horizons agree; and the diviſion ſhown by the index will be that required.

This adjuſtment may be performed by meaſuring the ſun's diameter in contrary directions, or by making the reflected and direct images of a ſtar or planet to coincide.

Uſe of the Circular Inſtrument.

To obſerve the diſtance between the ſun and moon.

I. The ſun being to the right of the moon.

Set a proper coloured glaſs before the central mirror, if the diſtance between the objects is leſs than 35°; but if above that quantity, place a coloured glaſs before the horizon mirror: make the mirrors parallel, the firſt index being at *o*, and hold the inſtrument ſo that its plane may be directed to the objects, with its face downwards, or from the obſerver: direct the ſight through the teleſcope to the moon: move the ſecond index, according to the order of the diviſions on the limb, till the neareſt limbs of the ſun and moon are almoſt in contact: faſten that index, and make the coincidence of the limbs perfect by the adjuſting ſcrew belonging thereto: then invert the inſtrument, and move the central index towards the ſecond by a quantity equal to twice the arch paſſed over by that index: direct the plane of the inſtrument to the objects: look directly to the moon, and the ſun will be ſeen in the field of the teleſcope: faſten the central index, and make the contact of the ſame two limbs exact by means of the adjuſting ſcrew: Then half the angle ſhown by the central index will be the diſtance between the neareſt limbs of the ſun and moon.

II. The ſun being to the left of the moon.

Hold the inſtrument with its face upwards, ſo that its plane may paſs through both objects; direct the teleſcope to the moon, and make its limb coincide with the neareſt limb of the ſun's reflected image, by moving the ſecond index: now put the inſtrument in an oppoſite poſition; direct its plane to the objects, and the ſight to the moon, the central index being previouſly moved towards the ſecond by a quantity equal to twice the meaſured diſtance; and make the ſame two limbs

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limbs that were before observed coincide exactly, by turning the adjusting screw of the first index: then half the angle shown by the first index will be the angular distance between the observed limbs of the sun and moon.

To observe the Angular Distance between the Moon and a Fixed Star or Planet.

I. The star being to the right of the moon.

In this case the star is to be considered as the direct object; and the enlightened limb of the moon's reflected image is to be brought in contact with the star or planet, both by a direct and inverted position of the instrument, exactly in the same manner as described in the last article. If the moon's image is very bright, the lightest tinged glass is to be used.

II. The star being to the left of the moon.

Proceed in the same manner as directed for observing the distance between the sun and moon, the sun being to the right of the moon, using the lightest tinged glass, if necessary.

SECT. IV. *Of the Method of determining the Longitude from Observation.*

PROB. I. To convert degrees or parts of the equator into time.

RULE. Multiply the degrees and parts of a degree by 4, beginning at the lowest denomination, and the product will be the corresponding time. Observing that minutes multiplied by 4 produce seconds of time, and degrees multiplied by 4 give minutes.

EXAMPLE I. Let 26° 45′ be reduced to time.

26° 45′
4

1h 47′ 0″ = time required.

EXAMPLE II. Reduce 83° 37′ to time.

83° 37′
4

Coresponding time = 5 34 28

PROB. II. To convert time into degrees.

RULE. Multiply the given time by 15, to which add the half of the product. The sum will be the corresponding degrees.

EXAMPLE I. Let 3h 4′ 28″ be reduced to degrees.

3h 4 28″
10

30 44 40
Half = 15 22 20

Corresponding deg. = 46 7 0

EXAMPLE II. Reduce 8h 42′ 36″ to degrees.

8h 42′ 36′
10

87 6 0
43 33 0

Answer 130 39 0

PROB. III. Given the time under any known meridian, to find the corresponding time at Greenwich.

RULE. Let the given time be reckoned from the preceding noon, to which the longitude of the place in time is to be applied by addition or subtraction, according as it is east or west; and the sum or difference will be the corresponding time at Greenwich.

EXAMPLE I. What time at Greenwich answers to 6h 15′ at a ship in longitude 76° 45′W?

Time at ship	- -	6h 15′
Longitude in time	-	5 7 W.
Time at Greenwich,	-	11 22

EXAMPLE II. Required the time at Greenwich answering to 5h 46′ 39″ of May 1st, at Canton, whose longitude is 113° 2′ 15″E.?

Time at Canton, May 1st		5h 46′ 39″
Longitude in time	-	7 32 9 E.
Time at Greenwich, April 30.		22 14 30

PROB. IV. To reduce the time at Greenwich to that under any given meridian.

RULE. Reckon the given time from the preceding noon, to which add the longitude in time of east, but subtract it if west; and the sum or remainder will be the corresponding time under the given meridian.

EXAMPLE I. What is the expected time of the beginning of the lunar eclipse of February 25. 1793, at a ship in longitude 109° 48′E?

Beg. of eclipse at Greenwich *per* Naut. Alm.		9h 23′ 45″
Ship's longitude in time,	-	7 19 12
Time of beginning of eclipse at ship,		16 42 57

EXAMPLE II. At what time may the immersion of the first satellite of Jupiter be observed at Port St Julian, in longitude 68° 44′W. which, by the Nautical Almanac, happens at Greenwich 24th March 1792, at 17h 53′ 1″?

App. time of immersion at Greenwich		17h 53′ 1″
Longitude of Port St Julian in time,		4 34 56 W.
App. time of immer. at Port St Julian,		13 18 5

PROB. V. To find the equation of equal altitudes.

RULE. To the cosecant of half the interval of time in degrees add the tangent of the latitude, and to the cotangent of half the interval add the tangent of the declination. Now if the latitude and declination be of a contrary name, add the corresponding natural numbers; but if of the same name, subtract them. Then to the ar. co. log. of this sum or difference add the proportional logarithm of one-fourth of the interval expressed in time, and the proportional logarithm of the daily variation of declination, the sum will be the proportional logarithm of the equation of equal altitudes in minutes and seconds, which are to be esteemed seconds and thirds.

EXAMPLE. Let the latitude of the place of observation be 57° 9′N, the interval of time between the observations of the equal altitudes 5h 17′, the sun's declination 17° 48′S, and the daily change of declination 16′ 19″½: Required the equation of equal altitudes?

Half the interval = 2h 38′½ = 39° 37′.

½ int. =	39° 37′	cos^t.	0.19542	cotang.	0.08209
Lat.	57 9	tan.	0.18997	dec. 17° 48′	ta. 9.50659
			0.38539	2.4288	
				3879	9.58868
Sum	- -			2.8167	ar.co.lo. 9.5503

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One-fourth interval	1h 19′ 15″	P.L. 0.3563
Daily variation of declination	16′ 19′½	P.L. 1.0424
Equation of equal altitudes	20″ 14‴	P.L. 0.9490

PROB. VI. To find the error of a watch by equal altitudes of the sun.

RULE. In the morning when the sun is more than two hours distant from the meridian, let a set of observations be taken, consisting, for the sake of greater accuracy, of at least three altitudes, which, together with the corresponding times *per* watch, are to be wrote regularly, the time of each observation being increased by 12 hours. In the afternoon, observe the instants when the sun comes to the same altitudes, and write down each opposite to its respective altitude.—Now half the sum of any two times answering to the same altitude will be the time of noon *per* watch uncorrect. Find the mean of all the times of noon thus deduced from each corresponding pair of observations, to which the equation of equal altitudes is to be applied by addition or subtraction according as the sun is receding from or approaching to the elevated pole, and the sum or difference will be the time *per* watch of apparent noon, the difference between which and noon will be the error of the watch for apparent time; and the watch will be fast or slow according as the time of noon thereby is more or less than twelve hours.

EXAMPLE. January 29th, 1786, in lat. 57° 9 N′, the following equal altitudes of the sun were observed: Required the error of the watch?

Alt.			Time							
= 8°	5′		21h	35′	8″	A.M.	2h	55″	43′	P.M.
8	10	-		36	8	-		54	42	
8	20	-		38	9	-		52	41.2	
8	25	-		39	12.5	-		51	38	
					37.5				4.2	
			21	37	9.37		2	53	41.05	
							21	37	9.37	
Sum	-	-	-				24	30	50.42	
Time of noon *per* watch uncorrected							12	15	25.2.	
Equation of equal altitudes							= 0	0	20.2.	
Time *per* watch of apparent noon							12	15	5.	
Watch fast	-	-						15	5.	

The mean time of noon *per* watch is found by applying the equation of time with a contrary sine.

In practice it will be found convenient to put the index of the quadrant to a certain division, and to wait till either limb of the sun attains that altitude.

PROB. VII. Given the latitude of a place, the altitude and declination of the sun, to find the apparent time, and the error of the watch.

RULE. If the latitude and declination are of different names, let their sum be taken; otherwise, their difference. From the natural cosine of this sum or difference subtract the natural sine of the corrected altitude, and find the logarithm of the remainder; to which add the log. secants of the latitude and declination: the sum will be the log. rising of the horary distance of the object from the meridian, and hence the apparent time will be known.

EXAMPLE I. September 15th 1792, in latitude 33° 56′ S, and longitude 18° 22′ E, the mean of the times per watch was 8h 12′ 10″ A. M. and that of the altitudes of the sun's lower limb 24° 48′; height of the eye 24 feet. Required the error of the watch?

Obs. alt. Sun's lower limb		24° 48′		Sun's declin. at noon per Nautical Almanac			2° 40′.5 S
Semidiameter	-	+ 16.0		Equation to 3h 48′ A. M.	-		+ 3.7
Dip	- -	— 4.7	-	to 18° 22′ East	-		+ 1.2
Correction	- -	— 1.9		Reduced declination	- -		2 45.4 S
True altitude Sun's centre		24 57.4					
Latitude	-	33 56	-	secant	- -		0.08109
Declination	- -	2 45.4	-	secant	- -		0.00050
Sum	- -	36 41.4		nat. cosine 80188			
Sun's altitude	- -	24 57.4		nat. sine 42193			
	- -	-		Difference 37995	-	log. -	4.57973
Sun's meridian distance	-	3h 48′ 51″	-	rising	-	-	4.66132
Apparent time	- -	8 11 9					
Time per watch	- -	8 12 10					
Watch fast	- -	1 1					

EXAMPLE. II. May 6th 1793, in latitude 56° 4′ N, and longitude 38° 30′ W, at 4h 37′ 4″ P. M. per watch, the altitude of the sun's lower limb was 25° 6′.1, and height of the eye 18 feet. Required the error of the watch for apparent time?

Altitude sun's lower limb	-	= 25° 6′.1		Sun's declin. per Nautical Almanac		16° 44′.3
Semidiameter	-	+ 15.9	-	Equation to 4h 37′ P. M.	-	+ 3.4
Dip	- -	— 4.1	-	- to 38° 30′ W	-	+ 1.8
Correction	- -	— 1.9		Reduced declination	-	16 49.5
True alt. sun's centre	-	25 16.0				

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Latitude	56 4.0 N		secant	0.25319	
Declination	16 49.5 N		secant	0.01900	
Difference	39 14.5	nat. cosine	77448		
Sun's altitude	25 16.0	nat. sine	42683		
		Difference	34765	4.54114	
Apparent time	4^h 38′ 12″		rising	4.81333	
Time per watch	4 37 4				
Watch slow	1 8				

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PROB. VIII. Given the latitude of a place, the altitude of a known fixed ſtar, and the ſun's right aſcenſion, to find the apparent time of obſervation and error of the watch.

RULE. Correct the obſerved altitude of the ſtar, and reduce its right aſcenſion and declination to the time of obſervation.

With the latitude of the place, the true altitude and declination of the ſtar, compute its horary diſtance from the meridian by laſt problem; which being added to or ſubtracted from its right aſcenſion according as it was obſerved in the weſtern or eaſtern hemiſphere, the ſum or remainder will be the right aſcenſion of the meridian.

From the right aſcenſion of the meridian ſubtract the ſun's right aſcenſion as given in the Nautical Almanac for the noon of the given day, and the remainder will be the approximate time of obſervation; from which ſubtract the proportional part of the daily variation of right aſcenſion anſwering thereto, and let the proportional part anſwering to the longitude be added or ſubtracted according as the longitude is eaſt or weſt, and the reſult will be the apparent time of obſervation; and hence the error of the watch will be known.

EXAMPLE I. December 12th 1792, in latitude 37° 46′ N, and longitude 21° 15′ E, the altitude of Arcturus eaſt of the meridian was 34° 6′.4, the height of the eye 10 feet. Required the apparent time of obſervation?

Obſerved alt. of Arcturus	34° 6′.4	
Dip and refraction	— 4.4	
True altitude	34 2.0	
Latitude	37 46.0 N.	ſec. 0.10209
Declination	20 14.4 N.	ſec. 0.02778
Difference	17 31.6 N	co. 0.95358
Altitude of Arcturus	34 2.0 N	ſine 55968
	Difference	393904.59539
Arcturus's merid. diſt.	4^h 8′ 10″	riſing 4.72526
right aſ.	14 6 13	
Right aſ. of merid.	9 58 3	
Sun's right aſ.	17 21 59	
Approximate time	16 36 4	
Eq. to approx. time	— 3 3	
Eq. to longitude	+ 16	
Ap. time of obſ.	16 33 17	

EXAMPLE II. January 29th 1792, in latitude 53° 24′ N, and longitude 25° 18′ W, by account, at 14^h 58′ 38″, the altitude of Procyon weſt of the meridian was 19° 58′; height of the eye 20 feet. Required the error of the watch?

Obſ. alt. of Procyon	19° 58′			
Dip and refraction	7			
True altitude	19 51			
Latitude	53 24		ſecant	0.22459
Declination	5 45		ſecant	0.00219
Difference	47 39	nat. coſ.	67366	
Altitude of Procyon	19 51	nat. ſine	33956	
		Difference	33410	4.52388
Procyon's merid. diſt.	4^h 16′ 24″		riſing	4.75066
right aſ.	7 28 24			
Right aſ. of merid.	11 44 48			
Sun's right aſ.	20 47 22			
Approximate time	14 57 26			
Eq. to ap. time	— 0 2 36			
Eq. to long.	— 0 0 17			
Apparent time	14 54 33			
Time per watch	14 58 38			
Watch faſt	0 4 5			

PROB. IX. Given the altitude of the moon, the latitude of a place, and the apparent time at Greenwich, to find the apparent time at the place of obſervation.

RULE. Correct the altitude of the moon's limb by Problem V. p. 731, and reduce its right aſcenſion and declination, and the ſun's right aſcenſion to the Greenwich time of obſervation. Now with the latitude of the place, the declination and altitude of the moon, compute its meridian diſtance as before: Which being applied to its right aſcenſion by addition or ſubtraction, according as it is in the weſtern or eaſtern hemiſphere, will give the right aſcenſion of the meridian. Then the ſun's right aſcenſion ſubtracted from the right aſcenſion of the meridian, will give the apparent time of obſervation.

EXAMPLE. March 3d 1792, in latitude 51° 38′ N, at 11^h 29′ 7′ P. M. per watch, the altitude of the moon's lower limb was 37° 31′, the height of the eye being 10 feet, and the time at Greenwich 13^h 43′. Required the error of the watch?

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Altitude of the moon's lower limb	= 37° 31′		Moon's right aſcenſion at Green. time			7h 22′ 54″	
Semidiameter - -	+ 15		declination - .			17° 0 N	
Dip - - -	— 3		Sun's right aſcenſion		-	23h 2′ 0″	
Correction -	+ 42						
Corrected alt. of moon's centre	38 25						
Latitude - -	51 38 N	-	ſecant	-	-	0.20712	
Declination - -	17 0 N	-	ſecant	-		0.01940	
Difference -	34 38	Nat. coſine	82281				
Moon's altitude - -	38 25	Nat. ſine	62138				
		Difference	20143			4.30412	
Moon's meridian diſtance	3° 14′ 36″	riſing	-	-	-	4.53064	
right aſcenſion -	7 22 54						
Right aſcenſion of meridian	10 37 30						
Sun's right aſcenſion -	23 2 0						
Apparent time at ſhip	11 35 30						
Time per watch	11 29 7						
Watch ſlow	6 23						

Of finding the Longitude at Sea by Lunar Obſervations.

PROB. X. Given the apparent diſtance between the moon and the ſun or a fixed ſtar, to find the true diſtance.

RULE. To the logarithmic difference anſwering to the moon's apparent altitude and horizontal parallax, add the logarithmic ſines of half the ſum, and half the difference of the apparent diſtance and difference of the apparent altitudes; half the ſum will be the logarithmic coſine of an arch: now add the logarithm ſines of the ſum and difference of this arch, and half the difference of the true altitudes, and half the ſum will be the logarithmic coſine of half the true diſtance.

EXAMPLE. Let the apparent altitude of the moon's centre be 48° 22′, that of the ſun's 27° 43′, the apparent central diſtance 81° 23′ 40″, and the moon's horizontal parallax 58′ 45″. Required the true diſtance?

Apparent altitude ſun's centre -	27° 43′ 0″	Apparent altitude moon's centre -			48° 22′ 0′
Correction - -	— 1 40	Correction - - -			+ 38 26′
Sun's true altitude - -	27 41 20	Moon's true altitude -			49 0 26
Sun's apparent altitude -	27 43	Sun's true altitude - -			27 41 20
Moon's apparent altitude -	48 22	Difference - -			21 19 6
Difference - -	20 39	Half - - -			10 39 33
Apparent diſtance . -	81 23 40	Logarithmic difference -			9.994638
Sum - - -	102 2 40	Half - 51° 1′ 20″	Sine -		9.890639
Difference - -	60 44 40	Half - 30 22 20	Sine -		9.703820
Half difference true altitudes -	10 39 33				19.589097
Arch - - -	51 27 29	- - coſine -			9.794548
Sum - - -	62 7 2	- - ſine -		-	9.946417
Difference - -	40 47 56	- - ſine -		-	9.815183
					19.761600
	40 32 16	- - coſine -		-	9.880800
	2				
True diſtance - -	81 4 32				

PROB. XI. To find the time at Greenwich anſwering to a given diſtance between the moon and the ſun, or one of the ſtars, uſed in the Nautical Almanac.

RULE. If the given diſtance is found in the Nautical Almanac oppoſite to the given day of the month, or to that which immediately precedes or follows it, the time is found at the top of the page. But if this diſtance is not found exactly in the ephemeris, ſubtract the prop. log. of the difference between the diſtances which immediately precede and follow the given diſtance; from the prop. log. of the difference between the given and preceding diſtances, the remainder will be the prop. log. of the exceſs of the time corre-

Of finding the Longitude at Sea by Lunar Observations.

corresponding to the given distance, above that answering to the preceding distance: And hence the apparent time at Greenwich is known.

Example. September 21. 1792, the true distance between the centres of the sun and moon was 68° 13′ 8″. Required the apparent time at Greenwich?

Given distance	68° 13′ 8″		
Dist. at ix hours	67 53 27	Diff. = 0° 19′ 41″	P. log. 9612
Dist. at xii hours	69 30 6	Diff. = 1 36 39	P. log. 2701
Excess - -		0 36 39	P. log. 6911
Preceding time -		9 0 0	
App. time at Greenwich		9 36 39	

Prob. XII. The latitude of a place and its longitude by account being given, together with the distance between, and the altitude of the moon and the sun, or one of the stars in the Nautical Almanac; to find the true longitude of the place of observation.

Rule. Reduce the estimate time of observation to the meridian of Greenwich by Problem III. and to this time, take from the Nautical Almanac, page vii. of the month, the moon's horizontal parallax and semidiameter. Increase the semidiameter by the augmentation answering to the moon's altitude.

Find the apparent and true altitudes of each object's centre, and the apparent central distance; with which compute the true distance by Problem X. and find the apparent time at Greenwich answering thereto by the last problem.

If the sun or star be at a proper distance from the meridian at the time of observation of the distance, compute the apparent time at the ship. If not, the error of the watch may be found from observations taken either before or after that of the distance; or the apparent time may be inferred from the moon's altitude taken with the distance, by Problem IX.

The difference between the apparent times of observation at the ship and Greenwich, will be the longitude of the ship in time; which is east or west according as the time at the ship is later or earlier than the Greenwich time.

Of finding the Longitude at Sea by Lunar Observations.

Example I. March 17. 1792, in latitude 34° 53′ N, and longitude by account 27° W, about 9h A. M. the distance between the nearest limbs of the sun and moon was 68° 3′¼; the altitude of the sun's lower limb 33° 18′; that of the moon's upper limb 31° 3′; and the height of the eye 12 feet. Required the true longitude of the ship?

Time at ship - -	9h 0′ A. M.	Dist. sun and moon's nearest limbs -	68° 3′ 15″
Longitude in time -	1 48	Sun's semidiameter - -	+ 16 6
Reduced time - -	10 48 A. M.	Moon's semidiameter - -	+ 16 10
Altitude moon's upper limb	31 3 0	Augmentation - -	+ 0 9
Aug. semidiameter -	— 16 19	Apparent central distance -	68 35 40
Dip - -	— 3 18	Altitude sun's lower limb -	33 18
Apparent altitude -	30 43 23	Sun's semidiameter - -	+ 16 6
Correction - -	+ 49 26	Dip - - -	— 3 18
Moon's true altitude -	31 32 49	Sun's apparent altitude - -	33 30 48
		Correction - -	— 0 1 19
		Sun's true altitude - -	33 29 29
		Moon's true altitude - -	31 32 49
		Difference - - -	1 56 40
		Half - - -	0 58 20

Sun's apparent altitude -	33° 30′ 48″			
Moon's apparent altitude -	30 43 23			
Difference - -	2 47 25	Logarithmic difference -		9.996336
Apparent distance -	68 35 40			
Sum - -	71 23 5	Half -	35° 41′ 32″½	Sine - 9.765991
Difference -	65 48 15	Half -	32 54 7½	Sine - 9.734964
				19.497291
Half difference true altitudes	0 58 20			
Arch - -	55 54 12			Cosine - 9.748645
Sum - -	56 52 32			Sine - 9.922977
Difference - -	54 55 52			Sine - 9.912998
				19.835975
Half true distance -	34 6 53 2			Cosine - 9.917987
True distance - -	68 13 46			

Of finding the Longitude at Sea by Lunar Observations.

True distance		68° 13′ 46″							
Distance at XXI hours	-	69 11 20	Difference	-	0° 57′ 34″	P. log.	=	4951	
Distance at noon	-	67 32 38	Difference	-	1 38 42	P. log.		2610	
Proportional part	-	-	-	-	1 45 0	Per. log.	-	2341	
Preceding time	-	-	-	-	21 0 0				
Apparent time at Greenwich			-	-	22 45 0				
Latitude -	34° 53′.0 N		Secant		-	-	-	0.08602	
Declination -	0 57.9 S		Secant		-	-	-	0.00006	
Sum -	35 50.9	Nat. cosine	-	81057					
Sun's altitude -	33 29.5	Nat. sine	-	55181					
Difference	- -	-		25876		-	-	4.41291	
Time from noon -	3h 7′ 13″	-	Rising		-	-		4.49899	
Apparent time -	20 52 47								
App. time at Green.	22 45 0								

Longitude in time - 1 52 13 = 28° 3′¼ W.

EXAMPLE II. September 2. 1792, in latitude 13° 57′ N, and longitude by account 56° E, several observations of the moon and altair were taken; the mean of the times *per* watch was 1h 18′ 59″ A. M. that of the distance between altair and the moon's nearest limb 58° 45′ 26″; the mean of the altitude of the moon's lower limb 70° 33′; and that of altair 25° 27′.4; height of the eye 13 feet. Required the true longitude?

Time *per* watch -	1h 18′ 59″ A. M.	Distance moon and altair - -	58° 45′ 26″
Longitude in time	3 44 0	Augmented semidiameter - -	+0 16 28
Reduced time -	9 34 59	Apparent central distance - -	59 1 54
Altitude moon -	70° 33′	Altitude of altair - - -	25° 27′.4
Semidiameter and dip	—0 13	Dip - - -	—0 3.4
Apparent alt. moon	70 20	Apparent altitude altair - - -	25 24 0
Correction -	+0 19 40	Refraction - - -	—0 2 0
True altitude moon	70 39 40	True altitude altair - -	25 22 0
Moon's apparent alt.	70 20	Moon's true altitude - -	70 39 40
Altair's apparent alt.	25 24	Difference - - -	45 17 40
Difference -	44 56	Half - - -	22 38 50
Apparent distance	59 1 54	Logarithmic difference - -	9.993101
Sum -	103 57 54	Half - 51° 58′ 57″	Sine - 9.896428
Difference -	14 5 54	Half - 7 2 57	Sine - 9.088919
Half diff. true alt.	22 38 50		18.978448
Arch -	72 1 57		Cosine - 9.489224
Sum -	94 40 47		Sine - 9.998548
Difference -	49 23 7		Sine - 9.880301
			19.878849
alf true distance	29 33 48½ (2)		Cosine - 9.939424
True distance -	59 7 37		
Distance at IX hours	58 51 17	Difference -	0° 16′ 20″ P. log. - 1.0422
— at XII hours	60 24 34	Difference -	1 33 17 P. log. - 0.2855
Proportional part -	- -		0 31 31 P. log. - 0.7567
Preceding time -	- -		9 0 0
Apparent time at Greenwich	-	-	9 31 31

Variation of the Compaſs.

Latitude -	13° 57′ N		Secant -	0.01300	Variation of the Compaſs.
Declination -	8 19.8 N		Secant -	0.00461	
Difference -	5 37.8	Nat. coſine -	99519		
Altitude altair -	25 22.	Nat. ſine -	42841		
Difference - -	-	-	56678	-	4.75341
Altair's meridian diſtance -	4h 23′ 14″	Riſing -	-	-	4.77102
—— right aſcenſion -	19 40 40				
Right aſcenſion meridian -	0 3 54				
Sun's right aſcenſion -	10 46 17				
Apparent time at ſhip -	13 17 37				
Apparent time at Greenwich	9 31 31				
Longitude in time -	3 46 6 = 56° 31′½ Eaſt.				

For various other methods of determining the longitude of a place, the reader is referred to the article LONGITUDE.

CHAP. III. *Of the Variation of the Compaſs.*

THE variation of the compaſs is the deviation of the points of the mariner's compaſs from the correſponding points of the horizon; and is denominated *eaſt* or *weſt* variation, according as the north point of the compaſs is to the eaſt or weſt of the true north point of the horizon.

A particular account of the variation, and of the ſeveral inſtruments uſed for determining it from obſervation, may be ſeen under the articles AZIMUTH, COMPASS, and VARIATION: and for the method of communicating magnetiſm to compaſs needles, ſee MAGNETISM.

PROB. I. Given the latitude of a place, and the ſun's magnetic amplitude, to find the variation of the compaſs.

RULE. To the log. ſecant of the latitude, add the log. ſine of the ſun's declination, the ſum will be the log. coſine of the true amplitude; to be reckoned from the north or ſouth according as the declination is north or ſouth.

The difference between the true and obſerved amplitudes, reckoned from the ſame point, and if of the ſame name, is the variation; but if of a different name, their ſum is the variation.

If the obſervation be made in the eaſtern hemiſphere, the variation will be eaſt or weſt according as the obſerved amplitude is nearer to or more remote from the north than the true amplitude. The contrary rule holds good in obſervations taken in the weſtern hemiſphere.

EXAMPLE I. May 15. 1794, in latitude 33° 10′ N, longitude 18° W, about 5h A. M. the ſun was obſerved to riſe E*b*N. Required the variation?

Sun's dec. May 15. at noon	18° 58′ N		
Equation to 7h from noon	—0 4		
—— to 18° W	+0 1		
Reduced declination	18 55	Sine	9.51080
Latitude -	33 10	Secant	0.07723
True amplitude -	N 67 13 E	Coſine	9.58803
True amplitude -	N 67 13 E	Coſine	9.58803
Obſerved amplitude	N 78 45 E		
Variation - -	11 32;		

which is *weſt*, becauſe the obſerved amplitude is more diſtant from the north than the true amplitude; the obſervation being made in the eaſtern hemiſphere.

EXAMPLE II. December 20. 1793, in latitude 31° 38′ S, longitude 83° W, the ſun was obſerved to ſet SW. Required the variation?

Latitude -	31° 38′	Secant -	0.06985
Declination -	23 28	Sine -	9.60012
True amplitude	S 62 7 W	Coſine	9.66997
Obſerved ampl.	S 45 0 W		
Variation	17 7;		

which is *eaſt*, as the obſerved amplitude is farther from the north than the true amplitude, the obſervation being made at ſun-ſetting.

It may be remarked, that the ſun's amplitude ought to be obſerved at the inſtant the altitude of its lower limb is equal to the ſum of 15 minutes and the dip of the horizon. Thus, if an obſerver be elevated 18 feet above the ſurface of the ſea, the amplitude ſhould be taken at the inſtant the altitude of the ſun's lower limb is 19 minutes.

PROB. II. Given the magnetic azimuth, the altitude and declination of the ſun, together with the latitude of the place of obſervation; to find the variation of the compaſs.

RULE. Reduce the ſun's declination to the time and place of obſervation, and compute the true altitude of the ſun's centre.

Find the ſum of the ſun's polar diſtance and altitude and the latitude of the place, take the difference between the half of this ſum and the polar diſtance.

To the log. ſecant of the altitude add the log. ſecant of the latitude, the log. coſine of the half ſum, and the log. coſine of the difference; half the ſum of theſe will be the log. ſine of half the ſun's true azimuth, to be reckoned from the ſouth in north latitude, but from the north in ſouth latitude.

The difference between the true and obſerved azimuths will be the variation as formerly.

Variation of the Compaſs.

EXAMPLE I. November 18. 1793, in latitude 50° 22′ N, longitude 24°30′ W, about three quarters paſt eight A. M. the altitude of the ſun's lower limb was 8° 10′, and bearing *per* compaſs S. 23° 18′ E; height of the eye 20 feet. Required the variation of the compaſs?

Variation of the Compaſs.

Sun's declin. 18th Nov. at noon	19° 25′ S.		Obſerved alt. ſun's lower limb		=8° 10
Equation to $3\frac{1}{4}^h$ from noon	— 2		Semidiameter		+ 16
——to 24° 30′ W	+ 1		Dip and refraction		— 10
Reduced declination	19 24		True altitude		8 16
Polar diſtance	109 24				
Altitude	8 16		Secant		0.00454
Latitude	50 22		Secant		0.19527
Sum	168 2				
Half	84 1		Coſine		9.01803
Difference	25 23		Coſine		9.95591
					19.17375
Half true azimuth	22 43 2		Sine		9.58687
True azimuth	S. 45 26 E.				
Obſerved azimuth	S. 23 18 E.				
Variation	22 8 W.				

EXAMPLE II. January 3. 1794, in latitude 33° 52′ N, longitude 53° 15′ E, about half paſt three the altitude of the ſun's lower limb 41° 18′, and azimuth S. 50° 25′ W. the height of the eye being 20 feet Required the variation?

Sun's declination at noon	21° 24′ S.		Obſerved alt. ſun's lower limb.		=41° 18
Equation to time from noon	— 2		Sun's ſemidiameter		+ 16
——to longitude	+ 2		Dip and refraction		— 6
Reduced declination	21 24 S.		True altitude		41 28
Polar diſtance	111 24				
Altitude	41 28		Secant		0.12532
Latitude	33 52		Secant		0.08075
Sum	186 44				
Half	93 22		Coſine		8.76883
Difference	18 2		Coſine		9.97558
					18.95048
	17 23 2		Sine		9.47524
True azimuth	S. 34 46 W.				
Obſerved azimuth	S. 50 25 W.				
Variation	15 39 W.				

CHAP. IV. *Of a Ship's Journal.*

A JOURNAL is a regular and exact regiſter of all the various tranſactions that happen aboard a ſhip whether at ſea or land, and more particularly that which concerns a ſhip's way, from whence her place at noon or any other time may be juſtly aſcertained.

That part of the account which is kept at ſea is called *ſea-work;* and the remarks taken down while the ſhip is in port are called *harbour-work.*

At ſea, the day begins at noon, and ends at the noon of the following day: the firſt 12 hours, or thoſe contained between noon and midnight, are denoted by P. M ſignifying *after mid-day;* and the other 12 hours, or thoſe from midnight to noon, are denoted by A. M. ſignifying *before mid-day.* A day's work marked Wedneſday March 6. began on Tueſday at noon, and ended on Wedneſday at noon. The days of the week are uſually repreſented by aſtronomical characters. Thus ☉ repreſents Sunday; ☽ Monday; ♂ Tueſday; ☿ Wedneſday; ♃ Thurſday; ♀ Friday; and ♄ Saturday.

When a ſhip is bound to a port ſo ſituated that ſhe will be out of ſight of land, the bearing and diſtance of the port muſt be found. This may be done by Mercator's or Middle-latitude Sailing; but the moſt expeditious method is by a chart. If iſlands, capes, or headlands intervene, it will be neceſſary to find the ſeveral courſe and diſtances between each ſucceſſively.

Ship's Journal.

ceſſively. The true courſe between the places muſt be reduced to the courſe *per* compaſs, by allowing the variation to the right or left of the true courſe, according as it is weſt or eaſt.

At the time of leaving the land, the bearing of ſome known place is to be obſerved, and its diſtance is uſually found by eſtimation. As perhaps the diſtance thus found will be liable to ſome error, particularly in hazy or foggy weather, or when that diſtance is conſiderable, it will therefore be proper to uſe the following method for this purpoſe.

Let the bearing be obſerved of the place from which the departure is to be taken; and the ſhip having run a certain diſtance on a direct courſe, the bearing of the ſame place is to be again obſerved. Now having one ſide of a plane triangle, namely the diſtance ſailed and all the angles, the other diſtances may be found by Prob. I. of Oblique Sailing.

The method of finding the courſe and diſtance ſailed in a given time is by the compaſs, the log line, and half-minute-glaſs. Theſe have been already deſcribed. In the royal navy, and in ſhips in the ſervice of the Eaſt India company, the log is hove once every hour; but in moſt other trading veſſels only every two hours.

The ſeveral courſes and diſtances ſailed in the courſe of 24 hours, or between noon and noon, and whatever remarks that are thought worthy of notice, are ſet down with chalk on a board painted black, called the *log-board*, which is uſually divided into ſix columns: the firſt column on the left hand contains the hours from noon to noon; the ſecond and third the knots and parts of a knot ſailed every hour, or every two hours, according as the log is marked; the fourth column contains the courſes ſteered; the fifth the winds; and in the ſixth the various remarks and phenomena are written. The log-board is tranſcribed every day at noon into the log-book, which is ruled and divided after the ſame manner.

The courſes ſteered muſt be corrected by the variation of the compaſs and leeway. If the variation is weſt, it muſt be allowed to the left hand of the courſe ſteered; but if eaſt, to the right hand in order to obtain the true courſe. The leeway is to be allowed to the right or left of the courſe ſteered according as the ſhip is on the larboard or ſtarboard tack. The method of finding the variation, which ſhould be determined daily if poſſible, is given in the preceding chapter; and the leeway may be underſtood from what follows.

When a ſhip is cloſe hauled, that part of the wind which acts upon the hull and rigging, together with a conſiderable part of the force which is exerted on the ſails, tends to drive her to the leeward. But ſince the bow of a ſhip expoſes leſs ſurface to the water than her ſide, the reſiſtance will be leſs in the firſt caſe than in the ſecond; the velocity in the direction of her head will therefore in moſt caſes be greater than the velocity in the direction of her ſide; and the ſhip's real courſe will be between the two directions. The angle formed between the line of her apparent courſe and the line ſhe really deſcribes through the water is called the *angle of leeway*, or ſimply the *leeway*.

There are many circumſtances which prevent the laying down rules for the allowance of leeway. The conſtruction of different veſſels, their trim with regard to the nature and quantity of their cargo, the poſition and magnitude of the ſail ſet, and the velocity of the ſhip, together with the ſwell of the ſea, are all ſuſceptible of great variation, and very much affect the leeway. The following rules are, however, uſually given for this purpoſe.

Ship's Journal.

1. When a ſhip is cloſe hauled, has all her ſails ſet, the water ſmooth, with a light breeze of wind, ſhe is then ſuppoſed to make little or no leeway.

2. Allow one point when the top-gallant ſails are handed.

3. Allow two points when under cloſe reefed topſails.

4. Allow two points and an half when one topſail is handed.

5. Allow three points and an half when both topſails are handed.

6. Allow four points when the fore-courſe is handed.

7. Allow five points when under the mainſail only.

8. Allow ſix points when under balanced mizen.

9. Allow ſeven points when under bare poles.

Theſe allowances may be of ſome uſe to work up the day's works of a journal which has been neglected; but a prudent navigator will never be guilty of this neglect. A very good method of eſtimating the leeway is to obſerve the bearing of the ſhip's wake as frequently as may be judged neceſſary; which may be conveniently enough done by drawing a ſmall ſemicircle on the tafferel, with its diameter at right angles to the ſhip's length, and dividing its circumference into points and quarters. The angle contained between the ſemidiameter which points right aft and that which points in the direction of the wake is the leeway. But the beſt and moſt rational way of bringing the leeway into the day's log is to have a compaſs or ſemicircle on the tafferel, as before deſcribed, with a low crutch or ſwivel in its centre: after heaving the log, the line may be ſlipped into the crutch juſt before it is drawn in, and the angle it makes on the limb with the line drawn right aft will ſhow the leeway very accurately; which as a neceſſary article, ought to be entered into a ſeparate column againſt the hourly diſtance on the log-board.

In hard blowing weather, with a contrary wind and a high ſea, it is impoſſible to gain any advantage by ſailing. In ſuch caſes, therefore, the object is to avoid as much as poſſible being driven back. With this intention it is uſual to lie to under no more ſail than is ſufficient to prevent the violent rolling which the veſſel would otherwiſe acquire, to the endangering her maſts, and ſtraining her timbers, &c. When a ſhip is brought to, the tiller is put cloſe over to the leeward, which brings her head round to the wind. The wind having then very little power on the ſails, the ſhip loſes her way through the water; which ceaſing to act on the rudder, her head falls off from the wind, the ſail which ſhe has ſet fills, and gives her freſh way through the water; which acting on the rudder brings her head again to the wind. Thus the ſhip has a kind of vibratory motion, coming up to the wind and falling off from it again alternately. Now the middle point between thoſe upon which ſhe comes up and falls off is

taken

Ship's Journal.

taken for her apparent courſe; and the leeway and variation is to be allowed from thence, to find the true courſe.

The ſetting and drift of currents, and the heave of the ſea, are to be marked down. Theſe are to be corrected by variation only.

The computation made from the ſeveral courſes corrected as above, and their correſponding diſtances, is called a *day's work*; and the ſhip's place, as deduced therefrom, is called her place by *account*, or *dead-reckoning*.

It is almoſt conſtantly found that the latitude by account does not agree with that by obſervation. From an attentive conſideration of the nature and form of the common log, that its place is alterable by the weight of the line, by currents, and other cauſes, and alſo the errors to which the courſe is liable, from the very often wrong poſition of the compaſs in the binnacle, the variation not being well aſcertained, an exact agreement of the latitudes cannot be expected.

When the difference of longitude is to be found by dead reckoning, if then the latitudes by account and obſervation diſagree, ſeveral writers on navigation have propoſed to apply a conjectural correction to the departure or difference of longitude. Thus, if the courſe be near the meridian, the error is wholly attributed to the diſtance, and the departure is to be increaſed or diminiſhed accordingly: if near the parallel, the courſe only is ſuppoſed to be erroneous; and if the courſe is towards the middle of the quadrant, the courſe and diſtance are both aſſumed wrong. This laſt correction will, according to different authors, place the ſhip upon oppoſite ſides of her meridian by account. As theſe corrections are, therefore, no better than gueſſing, they ſhould be abſolutely rejected.

If the latitudes are not found to agree, the navigator ought to examine his log-line and half-minute glaſs, and correct the diſtance accordingly. He is then to conſider if the variation and leeway have been properly aſcertained; if not, the courſes are to be again corrected, and no other alteration whatever is to be made on them. He is next to obſerve if the ſhip's place has been affected by a current or heave of the ſea, and to allow for them according to the beſt of his judgement. By applying theſe corrections, the latitudes will generally be found to agree tolerably well; and the longitude is not to receive any farther alteration.

Ship's Journal.

It will be proper, however, for the navigator to determine the longitude of the ſhip from obſervation as often as poſſible; and the reckoning is to be carried forward in the uſual manner from the laſt good obſervation: yet it will perhaps be very ſatisfactory to keep a ſeparate account of the longitude by dead-reckoning.

General Rules for working a Day's Work.

Correct the ſeveral courſes for variation and leeway; place them, and the correſponding diſtances, in a table prepared for that purpoſe. From whence, by Traverſe Sailing, find the difference of latitude and departure made good: hence the correſponding courſe and diſtance, and the ſhip's preſent latitude, will be known.

Find the middle latitude at the top or bottom of the Traverſe Table, and the diſtance, anſwering to the departure found in a latitude column, will be the difference of longitude: Or, the departure anſwering to the courſe made good, and the meridional difference of latitude in a latitude column, is the difference of longitude. The ſum, or difference of which, and the longitude left, according as they are of the ſame or of a contrary name, will be the ſhip's preſent longitude of the ſame name with the greater.

Compute the difference of latitude between the ſhip and the intended port, or any other place whoſe bearing and diſtance may be required: find alſo the meridional difference of latitude and the difference of longitude. Now the courſe anſwering the meridional difference of latitude found in a latitude column, and the difference of longitude in a departure column, will be the bearing of the place, and the diſtance anſwering to the difference of latitude will be the diſtance of the ſhip from the propoſed place. If theſe numbers exceed the limits of the Table, it will be neceſſary to take aliquot parts of them; and the diſtance is to be multiplied by the number by which the difference of latitude is divided.

It will ſometimes be neceſſary to keep an account of the meridian diſtance, eſpecially in the Baltic or Mediterranean trade, where charts are uſed in which the longitude is not marked. The meridian diſtance on the firſt day is that day's departure; and any other day it is equal to the ſum or difference of the preceding day's meridian diſtance and the day's departure, according as they are of the ſame or of a contrary denomination.

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Fig. 74.

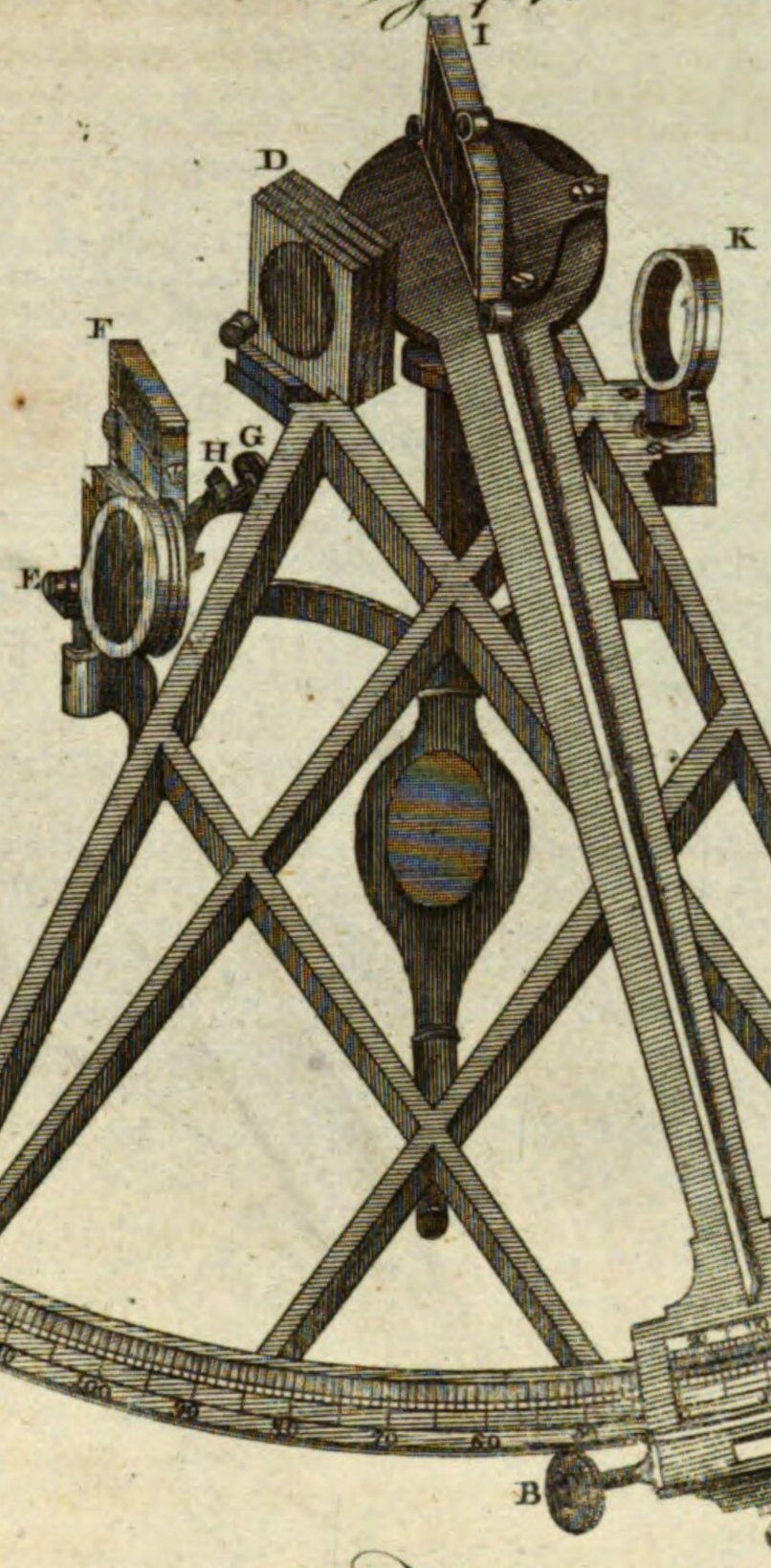

Fig. 75.

Fig. 76.

Fig. 77.

Fig. 78.

Fig. 79.

Fig. 80.

Fig. 83.

Fig. 84.

Fig. 85.

Fig. 81.

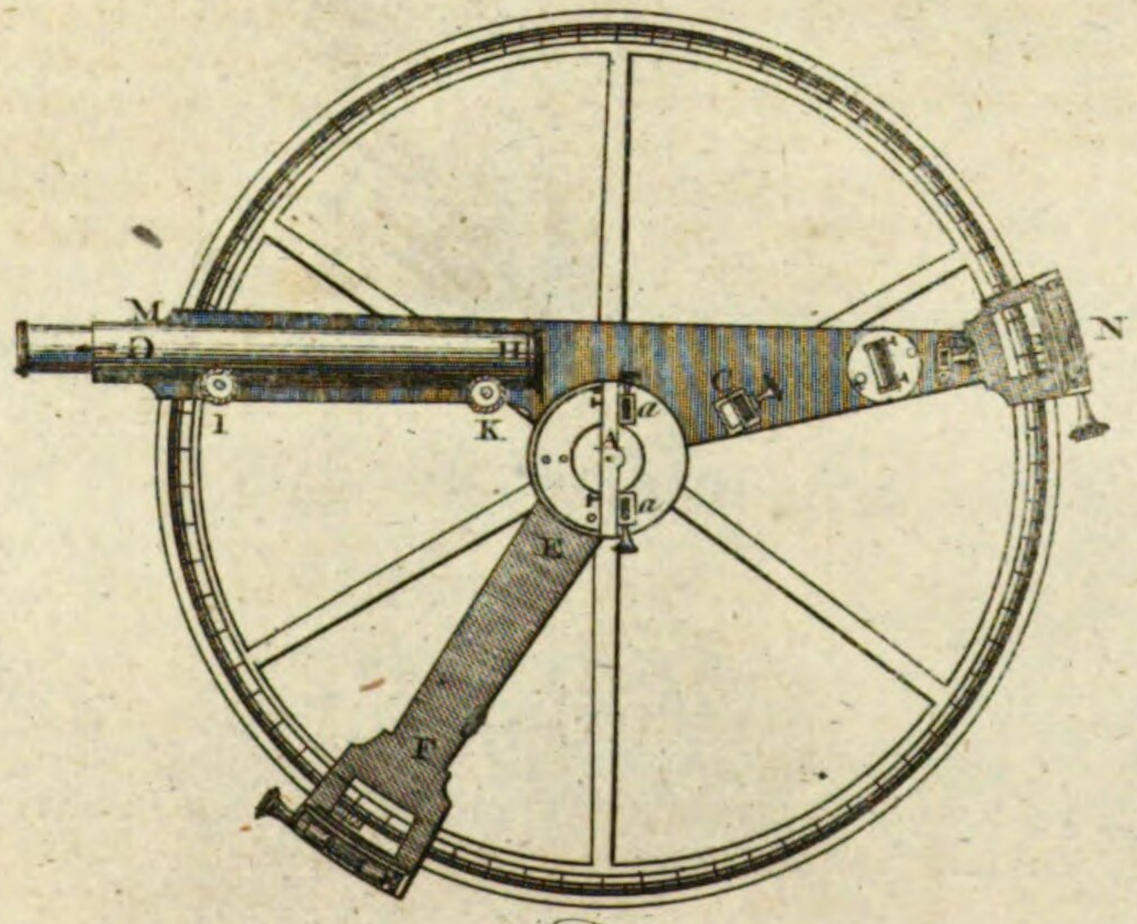

Fig. 82.

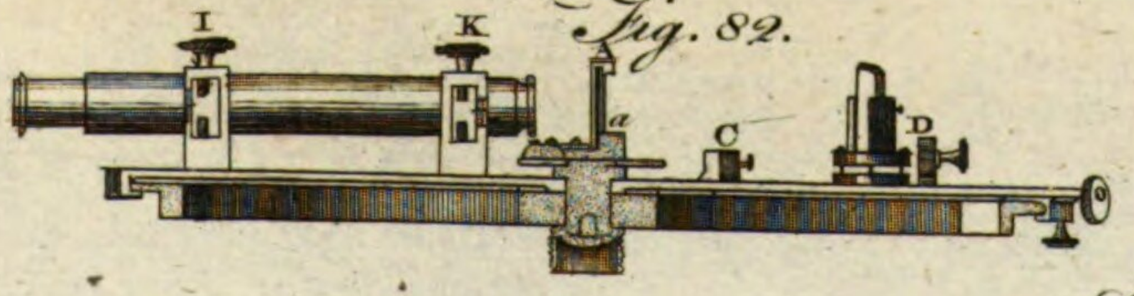

Fig. 86.

Fig. 87.

Fig. 88.

Fig. 89.

S. Bell Prin. Wal. Sculptor fecit.

Ship's Journal. A JOURNAL of a VOYAGE from London to Funchal in Madeira, in his Majeſty's Ship the Reſoluton, A—— M—— Commander, *anno* 1793. Ship's Journal

Days of Month.	Winds.	Remarks on board his Majeſty's ſhip Reſolution, 1793.
♄ Sept. 28.	SW	Strong gales and heavy rain. At 3 P. M. ſent down top-gallant yards; at 11 A. M. the pilot came on board.
☉ Sept. 29.	SW	Moderate and cloudy, with rain. At 10 A. M. caſt looſe from the ſheer hulk at Deptford; got up top-gallant yards, and made ſail down the river. At noon running through Blackwall reach.
☽ Sept. 30.	SW Variable	The firſt part moderate, the latter ſqually with rain. At half paſt one anchored at the Galleons, and moored ſhip with near a whole cable each way in 5 fathoms, a quarter of a mile off ſhore. At 3 A. M. ſtrong gales: got down top-gallant yards. A. M. the people employed working up junk. Bent the ſheet cable.
♂ Octob. 1.	SSW SW	Freſh gales and ſqually. P. M. received the remainder of the boatſwain's and carpenter's ſtores on board. The clerk of the cheque muſtered the ſhip's company.
☿ Octob. 2.	Variable NbE	Variable weather, with rain. At noon weighed and made ſail; at 5 anchored in Long-reach in 8 fathoms. Received the powder on board. At 6 A. M. weighed and got down the river. At 10 A. M. paſt the Nore; brought to and hoiſted in the boats; double reefed the topſails, and made ſail for the Downs. At noon running for the flats of Margate.
♃ Octob. 3.	NbE N	Firſt part ſtormy weather; latter moderate and clear. At 4 P. M. got through Margate Roads. At 5 run through the Downs; and at 6 anchored in Dover-road, in 10 fathoms muddy ground. Dover Caſtle bore north, and the ſouth Foreland NEbE¼E off ſhore 1¼ miles. Diſcharged the pilot. Employed making points, &c. for the ſails. Scaled the guns.
♀ Octob. 4.	N NNE	Moderate and fair. Employed working up junk. Received from Deal a cutter of 17 feet, with materials. A. M. ſtrong gales and ſqually, with rain; got down top-gallant yards.

Hours.	Kn.	Fa.	Courſes.	Winds.	Remarks, ♄ Oct. 5. 1793.
1				NNE	Freſh gales with rain.
2					Hove ſhort.
3					Weighed and made ſail.
4	4				
5	6		WSW		
6	7				
7	7				
8	7				Shortened ſail.—Dungeneſs light NEbE.
9	6	4	WbN	NE	
10	6				
11	6				
12	6				Freſh breezes, and cloudy.
1	6				
2	6				
3	6				
4	6				Ditto weather.
5	6				
6	6				Got up top-gallant yards.
7	6				Set ſtudding ſails.
8	7				Ditto weather.
9	7	5			
10	7	5			
11	7	6			
12	8				St Alban's Head N¼E.

A Journal

A Journal from England towards Madeira.

Hours.	Kn.	Fa.	Courſes.	Winds.	Remarks, ⊙ October 6. 1793.
1	8		W*b*N	NE	A freſh ſteady gale.
2	8				
3	8				
4	8				Do. weather.
5	8				Spoke the Ranger of London, from Carolina.
6	8				Took in ſtudding ſails.
7	8				
8	8				Do. weather.
9	8				
10	8				
11	8				Eddiſtone light N*b*W.
12	8				Do. weather.
1	8				Eddiſtone light NE.
2	7	5			
3	7	5			
4	7				Do. weather.
5	7		W*b*S		
6	7				Set lower ſtudding ſails.
7	7	4			
8	7	6			Freſh breeze and clear weather.
9	7	3			
10	7	5			
11	7	2			
12	7				Do. weather.

Courſe.	Diſt.	D L.	Dep.	N. Latitude by Acc.	N. Latitude by Obſ.	D. Long.	W. Lon. by Acc.	W. Lon. by Obſ.	W. Var.
S. 52° ¼ W.	93	57	74	49° 11′	49° 9′	114′ W.	6°18′		2¼ pts.

As there is no land in ſight this day at noon, and from the courſe and diſtance run ſince the laſt bearing of the Eddiſtone light was taken, it is not to be ſuppoſed that any part of England will be ſeen, the departure is therefore taken from the Eddiſtone; and the diſtance of the ſhip from that place is found by reſolving an oblique angled plane triangle, in which all the angles are given, and one ſide, namely, the diſtance run (16 miles) between the obſervations. Hence the diſtance from the Eddiſtone at the time the laſt bearing of the light was taken will be found equal to 18 miles; and as the bearing of the Eddiſtone from the ſhip at that time was NE, the ſhip's bearing from the Eddiſtone was SE. Now the variation 2¼ points W. being allowed to the left of SW. gives S*b*W ¼ W, the true courſe. The other courſes are in like manner to be corrected, and inſerted in the following table, together with their reſpective diſtances, beginning at 10 o'clock AM. the time when the laſt bearing of the Eddiſtone was taken. The difference of latitude, departure, courſe, and diſtance, made good, are to be found by Traverſe Sailing.

Courſes.	Diſt.	Diff. of lat. N.	Diff. of lat. S.	Departure E.	Departure W.
S*b*W ¼ W	18		17.0		6.1
W*b*S ¼ S	22		5.3		21.3
SW ¼ W	58		34.6		46 6
S 52½° W.	93		56.9 = 57m.		74.0
Latitude of Eddiſtone -			50 8N.		
Latitude by account -			49 11N.		
Sum - -			99 19		
Middle latitude - -			49 40		
Now to middle latitude as a courſe, and the departure 74m. in a latitude column, the difference of long. in a diſtance column is 114 =			1° 54′ W.		
Longitude of Eddiſtone -			4 24 W		
Longitude in by account -			6 18 W.		

Ship's Journal.

A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courſes.	Winds.	Remarks, ☽ October 7. 1793.
1	6	5	WSW.	NE.	Freſh breezes.
2	6	5			Sounded 62 ; fine ſand.
3	6				
4	5	3			Moderate and cloudy.
5	5				Unbent the cables, and coiled them.
6	5			N.	Took in ſtudding ſails.
7	5				
8	4	7			Do. weather.
9	4	5			
10	4	5			
11	4				
12	4				Do. weather.
1	4				
2	4				
3	4				
4	4				Light breeze.
5	3		SW*b*W.	NW.	
6	3				A ſail S*b*E.
7	3				
8	3				Hazy weather.
9	3		SW.	Var.	
10	3				
11	3				
12	2				Do. weather.

Courſe.	Diſt.	D L.	Dep.	N. Latitude by Acc.	N. Latitude by Obſ.	D. Long.	W. Long. by Acc.	W. Long. by Obſ.	W. Var. by ac.	Porto Sancto's Bearing.	Porto Sancto's Diſtance.
S 38° W.	99	78	62	47° 51′		93′ W.	7° 51′		2¼ pts.	S 23°½ W.	974 m.

The courſes being corrected for variation, and the diſtances ſummed up, the work will be as under.

Courſes.	Diſt.	Diff. of latitude. N.	Diff. of latitude. S.	Departure. E.	Departure. W.
SW¼S.	77		57.0		51.7
SSW ¾ W.	12		10.3		6.2
S*b*W ¼ W.	11		10.4		3.7
S 38°W.	99		77.7		61.6
			1° 18′		

Yeſterday's lat. by obſer. = 49 9 N.
Latitude by account = 47 51 N.
Sum - 97 0
Middle latitude - 48 30

To middle latitude 48½°, and departure 61.6 in a latitude column, the correſponding difference of longitude in a diſtance column is 93′ - = 1° 33 W.
Yeſterday's longitude - 6 18 W.
Longitude in by account 7 51 W.

It is now neceſſary to find the bearing and diſtance of the intended port, namely, Funchal; but as that place is on the oppoſite ſide of the iſland with reſpect to the ſhip, it is therefore more proper to find the bearing of the eaſt or weſt end of Madeira ; the eaſt end is, however, preferable. But as the ſmall iſland of Porto Sancto lies a little to the NE of the eaſt end of Madeira, it therefore ſeems more eligible to find the bearing and diſtance of that iſland. To find the bearing and diſtance of Porto Sancto.

Latitude of ſhip	47° 51 N.	Mer. parts	3278	Longitude of ſhip	7° 51 W.
Lat. of Porto Sancto	32 58 N.	Mer. parts	2097	Lon. Porto Sancto	16 25 W.
Difference of latitude	14 53 = 893	M.D. lat.	1181	Difference of long.	8 34 = 514

The courſe anſwering to the meridional difference of latitude and difference of longitude is about 23°½, and the diſtance correſponding to the difference of latitude is 974 miles. Now as Porto Sancto lies to the ſouthward and weſtward of the ſhip, the courſe is therefore S 23°½W ; and the variation, becauſe W. being allowed to the right hand, gives SW ¼ W nearly, the bearing *per* compaſs ; and which is the courſe that ought to be ſteered.

A Journal from England towards Madeira.

Hours.	Kn.	Fa.	Courſes.	Winds.	Remarks, ♂ October 8. 1793.
1	2		SW	NW Variable.	Little wind and cloudy.
2	1				Tried the current and found none.
3					
4			Ship's head to the SW.		Calm.
5					
6					
7			Ship's head from SW to SSE.		Calm; a long ſwell from the SW.
8					
9					
10	1		WSW	S	
11	1				
12	2				Light airs and hazy.
1	2				
2	2				
3	2				
4	3				Moderate wind and cloudy.
5	3		W	S♭W	
6	4				Set top-gallant ſails.
7	5				
8	5				
9	5				
10	5		W ½ N	SSW	
11	5				By double altitudes of the ſun, the latitude was found to be 47° 28′ N.
12	5				

Courſe.	Diſt.	D.L.	Dep.	N. Latit. by Acc.	N. Latit. by Obſ.	D. Long.	W. Long. by Acc.	W. Long. by Obſ.	W. Var.	Porto Sancto's Bearing.	Porto Sancto's Diſtance.
S 61° W.	51	25	45	47° 26′	47° 28′	67′ W.	8° 58′		2 points	S 21° W	932

The ſeveral courſes corrected will be as under.

Courſes.	Diſt.	Diff. of latitude N	Diff. of latitude S	Departure.	Departure. W
SSW	3		2.8		1.1
SW	13		9.2		9.2
WSW	22		8.4		20.3
W♭S ½ S	15		4.4		14.4
S 61° W	51		24.8	= 25	45.0

Yeſterday's latitude 47 51

Latitude by account 47 26
Sum - - 77
Middle latitude - 47 39

To middle latitude 47 ⅓°, and departure 45′ in a latitude column, the difference of longitude in a diſtance column is 67′ = 1° 7′ W
Yeſterday's longitude 7 51 W

Longitude in by account 8 58 W

To find the bearing and diſtance of Porto Sancto.

Latitude of ſhip	47° 28 N	Mer. parts	3244	Longitude	8° 58′ W
Lat. of Porto Sancto	32 58 N	Mer. parts	2097	Longitude	16 25 W
Difference of latitude	14 30 = 870 M.	D. lat.	1147	D. longitude	7 27=447′.

Hence the bearing of Porto Sancto is S21°W, and diſtance 932 miles. The courſe per compaſs is therefore SW nearly.

Ship's Journal.

A Journal from England to Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courſes.	Winds.	Remarks, ☿ October 9 1793.
1	5		W*b*N	SW*b*S	Squally with rain.
2	5				Handed top-gallant ſails.
3	5	5			In 1ſt reef topſails.
4	5	4			Dark gloomy weather. Tacked ſhip.
5	5	6	SE*b*S		
6	5				In 2d reef topſails, and down top-gallant yards.
7	4				
8	4				Stormy weather; in fore and mizen topſails and 3d
9	3				reef maintop ſail. Handed the maintop ſail, bent
10			up SE*b*S off ESE		the main-ſtay ſail, and brought to with it and the
11	}		up WSW off WNW		mizen; reefed the mainſail, at 10, wore and lay to
12	}				under the mainſail, got down top-gallant maſts;
1	3		W*b*N		at 12 ſet the foreſail, and balanced the mizen.
2	3	6			
3	3	5	WNW	SW	The ſea ſtove in ſeveral half ports.
4	3	5			
5	4				The ſwell abates a little.
6	4		W*b*N	SW*b*S	
7	3	2			The ſwell abates faſt.
8	3	4			Up top-gallant maſts.
9	3	4	W	SSW	
10	4				Set the topſails.
11	5				
12	5				Clear weather; good obſervation.

Courſe.	Diſt.	D.L	Dep.	N. latit. by Acc.	N. latit. by Obſ.	D.Long.	W. Long. by Acc.	W. Long. by Obſ.	W.Var.	Porto Sancto's Bearing	Porto Sancto's Diſtance
W*b*N½N	43	12	41	47° 40′	47° 39′	61′	9° 59′		2 points.		

There is no leeway allowed until 2 o'clock P. M. when the top-gallant ſails are taken in; from 2 to 3 one point is allowed; from 3 to 6, one and a half points are allowed; from 6 to 8, one and three-fourth points are allowed: from 8 to 9, three points; from 9 to 10, four and an half points; from 10 to 12, five points; from 12 to 10 A. M. three and an half points; and from thence to noon two points leeway are allowed. Now the ſeveral courſes being corrected by variation and leeway will be as under; but as the corrected courſes from 2 to 3 P. M. and from 10 to 12 A. M. are the ſame, namely, weſt; this, therefore, is inſerted in the table, together with the ſum of the diſtances, as a ſingle courſe and diſtance. In like manner the courſes from 12 to 2, and from 5 to 8 being the ſame, are inſerted as a ſingle courſe and diſtance.

Courſes.	Diſt.	Diff. of latit. N	Diff. of latit. S	Departure. E	Departure. W
W*b*S	10		2.0		9.8
W	15.5				15.5
W½N	5.4	0.5			5.4
E*b*S½S	10.6		3.1	10.1	
E*b*S¼S	8		1.9	8.7	
E	3			3.0	
NE*b*E	1	0.6		0.8	
NW*b*W	2	1.1			1.7
NW*b*W½W	17.2	8.1			15.2
NW¼W	11	7.0			8.5
W*b*N½N	7.4	2.1			7.1
		19.4	7.0	21.7	63.2
		7.0			21.7
W*b*N½N	43	1 4			41.5

Yeſt. latitude 47 28 N
Lat. by account 47 40 N
To middle latitude 47° 34′, and departure 41.5
the difference of longitude is 61′ = 1° 1′ W
Yeſterday's longitude 8 58 W
Longitude in by account 9 59 W

A Journal

Ship's Journal.

A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courſes.	Winds.	Remarks, 24 October 10. 1793.
1	5	3	W	SSW	Freſh gales with rain.
2	5	7			
3	6				
4	6				Do. weather.
5	6				Out 3d reef topſails.
6	6				Loſt a log and line.
7	5	6			
8	5	4			Do. weather.
9	5	5			
10	5	2			
11	5				
12	5				Do. weather.
1	5	5			
2	5				
3	5				
4	4				Moderate and cloudy, out all reefs.
5	4		WSW	S	
6	4				Sprung fore top-gallant yard, got up another.
7	4	3			
8	4	4	SW*b*W	SSE	Do. weather.
9	4	6			A ſail NE.
10	5	3			Employed working up junk.
11	5	4		SE*b*S	A ſwell from the NW, which by eſtimation has
12	5				ſet ſhip 7 miles in the oppoſite direction.

Courſe.	Diſt.	D.L.	Dep.	N. Latit. by Acc.	N. Latit. by Obſ.	D. Long.	W. Long. by Acc.	W. Long. by Obſ.	W. Var.	Porto Sancto's Bearing.	Porto Sancto's Diſtance.
S 74° W.	108	30	104	47° 9′		153′ W.	12° 32′		2 Points.	S 12° W.	870 m.

Two points leeway are allowed on the firſt courſe, one on the ſecond; and as the ſhip is 7 points from the wind on the third courſe, there is no leeway allowed on it. The oppoſite point to NW, that from which the ſwell ſet, with the variation allowed upon it, is the laſt courſe in the Traverſe Table.

Courſes.	Diſt.	Diff. of Latitude. N.	Diff. of Latitude. S.	Departure. E.	Departure. W.
W	86.2				86.2
SW*b*W	12.3		6.8		10.2
SW*b*S	24.7		20.5		13.7
ESE	7		2.7	6.5	
S 74 W	108		30.0	6.5	110.1
Yeſterday's latitude		47 39			6.5
Latitude by account		47 9			103.6
Sum -		48			
Middle latitude		47 24			
To middle latitude 47 24, and departure 103.6, the difference of longitude is 153′		=		2° 33 W	
Yeſterday's longitude			-	9 59 W	
Longitude in -			-	12 32 W	

To find the bearing and diſtance of Porto Sancto.

Latitude of ſhip -	47° 9′ Mer. parts -	3216	Longitude -	12° 32′ W	
Lat. Porto Sancto -	32 58 Mer. parts -	2097	Longitude -	16 25 W	
Difference of latitude	14 11=851′ M. D. lat.	1119	D. longitude -	3 53=233.	

Hence the bearing of Porto Sancto is S 12° W, and diſtance 870 miles; the courſe *per* compaſs is therefore about SW*b*W.

A Journal from England to Madeira.

Hours.	Kn.	Fa.	Courſes.	Winds.	Remarks, ♀ October 11. 1793.
1	4		SW*b*S	ESE	Moderate wind and fair weather.
2	3				Shortened ſail and ſet up the topmaſt rigging.
3	2				
4	3				Do. weather.
5	4				Variation *per* amplitude 21° W.
6	4	6			
7	4	4			
8	4	5			A fine ſteady breeze.
9	5			E	By an obſervation of the moon's diſtance from α Pegaſi, the ſhip's longitude at half paſt 8 was 12° 28′ W.
10	5				
11	5				
12	5	2			Clear weather.
1	5	7			
2	6				
3	6			ENE	
4	6				Do. weather.
5	6	2			
6	6				
7	6	3			
8	6				Set ſtudding ſails, &c.
9	7				
10	7				One ſail in ſight.
11	8				
12	8				Do. weather, good obſervation.

Courſe.	Diſt.	D.L	Dep.	N. Latit. by		D. Long.	W. Long. by		W. Var. Obſerved.	Porto Sancto's	
				Acc.	Obſ.		Acc.	Obſ.		Bearing.	Diſtance.
S 12° 45′ W.	128	125	28	45 4′	44° 59′	41′ W.	13° 13′	12° 59′	21°	S 12° W.	737 miles.

The obſerved variation 21° being allowed to the left of SW*b*S gives S 12° 45′ W, the corrected courſe, and the diſtance ſummed up is 127.9, or 128 miles. Hence the difference of latitude is 124.8, and the departure 28.2 The latitude by account is therefore 45° 4′ N, and the middle latitude 46° 6′, to which, and the departure 28.2 in a latitude column, the difference of longitude in a diſtance column is 41′ W; which being added to 12° 32′ W, the yeſterday's longitude, gives 13° 13′ W, the longitude in by account. But the longitude by obſervation was 12° 28 W at half paſt 8 P.M.; ſince that time the ſhip has run 96 miles; hence the departure in that interval is 21.2 m. Now half the difference of latitude 47 m. added to 44° 59′, the latitude by obſervation at noon, the ſum 45° 46′ is the middle latitude; with which and the departure 21.2, the difference of longitude is found to be 31′ W; which therefore added to 12° 28′, the longitude obſerved, the ſum is 12° 59′ W, the longitude by obſervation reduced to noon.

To find the bearing and diſtance of Porto Sancto.

Latitude ſhip	-	44° 59′ N. Mer. parts	-	3028	Longitude	-	12° 59′ W
Lat. Porto Sancto		32 58 N. Mer. parts	-	2097	Longitude	-	16 25 W
Difference of latitude		12 1=721.		M. D. lat. 931	D. longitude	-	3 26=206′

Hence the bearing of Porto Sancto is S 12° W, and diſtance 737 miles. The courſe to be ſteered is therefore S 33° W, or SW*b*S nearly.

A Jour-

Ship's Journal.

A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courſes.	Winds.	Remarks, ½ October 12. 1793.
1	8		SW½S.	E½N.	Freſh gales, and cloudy.
2	7	5			
3	8				
4	8	6			Do. Weather.
5	8	4			
6	8				Hauled down ſtudding-ſails.
7	7	5			
8	7	3			Do. Weather.
9	7	4			
10	7	2			
11	7	6			
12	7	5		ENE.	A ſteady gale and fine weather.
1	7				
2	7	5			
3	7				
4	7	3			Do. Weather.
5	7	2			
6	7				
7	7	4			Out ſtudding-ſails alow and aloft.
8	8				Variation *per* azimuth 20° 14′ W.
9	8				A ſail in the SW quarter.
10	8				
11	7	6			Sailmaker altering a lower ſtudding-ſail.
12	8				Fine weather, and cloudy.

Courſe.	Diſt.	D.L.	Dep.	N. Latit. by Acc.	N. Latit. by Obſ.	D.Long.	W. Long. by Acc.	W. Long. by Obſ.	W. Var. Obſ.	Porto Sancto's Bearing.	Porto Sancto's Diſtance.
S 13° 31′ W.	183	178	43	42° 1′		59′ W.	14° 12′	13° 58′	20° 14′	S 12° W.	555 m.

The courſe corrected by variation is S 13° 31′ W, and the diſtance run is 183 miles: hence the difference of latitude is 177.9, and the departure 42.8.

Yeſterday's latitude by obſervation -	44° 59′ N.	Mer. parts - - -	3028	
Difference of latitude -	2 58 S.			
Latitude in by account -	42 1 N.	Mer. parts - -	2783	
Meridional difference of latitude -	-	-	-	245

Now to courſe 13°½, and meridional difference of latitude 245 in a latitude column, the difference of longitude in a departure column is 59′ W: hence the yeſterday's longitudes by account and obſervation, reduced to the noon of this day, will be 14° 12′ W and 13° 58′ reſpectively.

To find the bearing and diſtance of Porto Sancto.

Latitude ſhip -	42° 1′ N.	Mer. parts -	2783	Longitude -	13° 58′ W.	
Lat. Porto Sancto	32 58 N.	Mer. parts -	2097	Longitude -	16 25 W.	
Difference of latitude	9 3 = 543	M. D. latitude	686	D. longitude -	2 27 = 147.	

The meridional difference of latitude and difference of longitude will be found to agree neareſt under 12°, the correct bearing of Porto Sancto; and the variation being allowed to the right hand of S 12° W, gives S. 32°¼ W, the bearing *per* compaſs; and the diſtance anſwering to the difference of latitude 543, under 12 degrees, is 555 miles.

A Journal

A Journal from England towards Madeira.

Hours.	Kn.	Fa.	Courſes.	Winds.	Remarks, ⊙ October 13. 1793.
1	8		SW*b*S.	ENE.	A ſteady gale, and fine weather.
2	8	5			
3	8	6			At 34 minutes paſt three, the diſtance between the neareſt limbs of the ſun and moon, together with the altitude of each, were obſerved; from whence the ſhip's longitude at that time is 14° 1′ W.
4	8				
5	8				
6	8	4			
7	8				
8	7	5			Hauled in the lower ſtudding-ſails.
9	7				At 9h 22′, by an obſervation of the moon's diſtance from α Pegaſi, the longitude was 14° 20′ W.
10	7				
11	7				
12	7				Freſh gales, and clear.
1	7			ESE.	
2	8				
3	7				
4	7				Do. weather.
5	7				
6	7				
7	8				Variation *per* amplitude 19° 51′ W.
8	8				Do. *per* azimuth 19° 28′ W. Set ſtudding-ſails.
9	8	4			
10	8	2			Carried away a fore-top-maſt ſtudding-ſail boom, got up another.
11	8				
12	7	4			Freſh gales. Took in ſtudding-ſails.

Courſe.	Diſt.	D.L	Dep.	N. latit. by Acc	N. latit. by Obſ.	D. Long.	W. Long. by Acc.	W. Long. by Obſ.	W. Var. by Obſ.	Porto Santo's Bearing.	Porto Santo's Diſtance.
S*b*W¼W.	184	178	45	39° 3′		59′ W.	15° 11′	14° 52′	1¾ pts.		

The mean of the variations is about 1¾ points W: hence the courſe corrected is S*b*W¼W; with which and the diſtance run 184 miles, the difference of latitude is 178.5, and the departure 44.7.

Yeſterday's latitude - -	42° 1′ N.	Mer. parts - -	2783
Difference of latitude - -	2 58 S.		
Latitude in by account -	39 3 N.	Mer. parts -	2549
Meridional difference of latitude -	-	- - -	234

Now, to courſe 1¾ points, and meridional difference of latitude 234, the difference of longitude is about 59 m.; which, added to the yeſterday's longitude by account 14° 12′ W, the ſum 15° 11′ W is the longitude in by account at noon. The longitudes by obſervation are reduced to noon as follow:

The diſtance run between noon and 3h 34′ P. M. is 29 miles; to which, and the courſe 1¼ points, the difference of latitude is - - 28′

Yeſterday's latitude at noon - -	42 1 N.		
Latitude at time of obſervation -	41 33 N.	Mer. parts - -	2746
Latitude at noon - -	39 3 N.	Mer. parts - -	2549
Meridional difference of latitude -	-	- - -	197

Then, to courſe 1¼ points, and meridional difference of latitude 197 in a latitude column, the difference of longitude in a departure column is 49′ W; which added to 14° 1′ W, the longitude by obſervation, the ſum 14° 50′ W is the longitude reduced to noon.

Again, the diſtance run between the preceding noon and 9h 22′ P. M. is 75 miles: hence the correſponding difference of latitude is 72.8, or 73 miles; the ſhip's latitude at that time is therefore 40° 48′ N.

Latitude at time of obſervation -	40° 48′ N.	Mer. parts -	2686
Latitude at noon - -	39 3 N.	Mer. parts -	2549
Meridional difference of latitude -	-	- - -	137

Now with the corrected courſe, and meridional difference of latitude, the difference of longitude is 34′ W; which added to 14° 20′ W, the ſum is 14° 54′ W, the reduced longitude. The mean of which and the former reduced longitude is 14° 52′ W, the correct longitude.

A Journal

Ship's Journal.

A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courſes.	Winds.	Remarks, ☽ October 14. 1793.
1	8		SW*b*S	E*b*S	Freſh gales and hazy, ſingle reefed topſails.
2	7	5			
3	7	5			Got down top-gallant yards.
4	7				Do. weather, and a confuſed ſwell running;
5	7	4	SSW		
6	7	1			
7	7				
8	6	5			More moderate.
9	6			Variable.	
10	5				
11	5				
12	4				Do. with lightning all round the compaſs.
1	3				
2	3				
3	3	5	SW*b*S	SE*b*S	
4	4				Squally, with rain.
5	5				
6	4				
7	2	5			
8	2		SW	SSE	Moderate weather; out reefs, and up top-gallant-yards.
9	3				
10	3	5			
11	4	5	WSW	S	At 11h 10′ A.M. the latitude from double altitudes of the ſun was 37° 10′. Clear weather.
12	5				

Courſe.	Dif.	DL.	Dep.	N. Latitude by Acc.	N. Latitude by Obſ.	D. Long.	W. Long. by Acc.	W. Long. by Obſ.	W. Var.	Porto Sancto's Bearing.	Porto Sancto's Diſtance.
S 16°W.	116	111	32	37° 12′	37° 8′	41′W.	15° 52′	15° 33′	1¼ pts.	S10°W.	254 m.

As the ſhip is cloſe hauled from 2 o'clock AM. 1¼ points leeway are allowed upon that courſe, and 1 point on the two following courſes.

Courſes.	Diſt.	Diff. of latitude. N.	Diff. of latitude. S.	Departure. E.	Departure. W.
S*b*W¼W	30		29.1		7.3
S¼W	54		53.9		2.7
SSW½W.	19		16.8		9.0
SW¾S	8.5		6.8		5.1
SW*b*W¼W.	9.5		4.9		8.1
S16°W.	116		111.5 = 1° 51		32.2

Yeſterday's latitude - 39 3
Latitude in by account 37 12
} M. lat. 38°7

To middle latitude 38°, and departure 32.2 in a latitude column, the difference of longitude in a diſtance column is 41′.

Yeſterday's lon. by account 15° 11′W. by ob. 14° 52′W.
Difference of longitude 41 W. 41 W.
Longitude in 15 22 15 33 W.

The latitude by obſervation at 11h 10′ A.M. is 37° 10′, and from that time till noon the ſhip has run about 4 miles. Hence the correſponding difference of latitude is 2 miles, which ſubtracted from the latitude obſerved, gives 37° 8′, the latitude reduced to noon.

To find the bearing and diſtance of Porto Sancto.

Latitude of ſhip	37° 8 N.	Mer. parts 2403	Longitude	15° 33 W.	
Latitude Porto Sancto	32 58 N.	Mer. parts 2097	Longitude	16 25 W.	
Difference of latitude	4 10 = 250 M.	D. Lat. 306	Diff. long.	52	

Hence the bearing of Porto Sancto is S. 10°W, or SSW ¼ W nearly, *per* compaſs, and the diſtance is 254 miles.

Ship's Journal.

A Journal from England towards Madeira.

Ship's Journal.

Hours	Kn.	Fa.	Courſes.	Winds.	Remarks, ♂ October 15. 1793.
1	4		W*b*S	S*b*W	Moderate and clear weather.
2	4				
3	3	6			Employed working points and rope-bands.
4	3				Ditto weather.
5	3	4			
6	3		W*b*N	SW*b*S	
7	3				
8	3	2			Fine clear weather.
9	4				
10	4				
11	3	5			
12	3	3		Variable.	Ditto weather.
1	3				
2	4		W		
3	3				
4	2		WNW		
5	2	4	NW*b*W	SW*b*W	
6	3				
7	3				Variation per mean of ſeveral azimuths 18° 0′ W.
8	3	6			Ditto weather. Tacked ſhip.
9	4		S*b*E		
10	5				Sail-makers making wind-ſails.
11	5	4			
12	5	6			A fine ſteady breeze. Cloudy.

Courſe.	Diſt.	D.L.	Dep.	N. Lat by Acc.	N. Lat by Obſ.	D. Long.	W. Long. by Account.	W. Long. by Obſerv.	W. Var. by Obſ.	Porto Sancto's. Bearing.	Porto Sancto's. Diſtance.
S 68° W	56	21	52	36° 47′		65′ W	16° 57′	16° 38′	18°	S¼E	229

Half a point of leeway is allowed on each courſe; but as the variation is expreſſed in degrees, it will be more convenient and accurate to reduce the ſeveral courſes into one, leeway only being allowed upon them. The courſe thus found is then to be corrected for variation, with which and the diſtance made good the difference of latitude and departure are to be found.

Courſes.	Diſt.	Diff. of Latitude. N	Diff. of Latitude. S	Departure. E	Departure. W
W½S	18		1.8		17.9
W*b*N½N	27	7.8			25.8
W½N	7	0.7			7.0
NW*b*W½W	2	0.9			1.8
NW½W	12	7.6			9.3
S*b*E½E	20		19.1	5.8	
		17.0	20.9	5.8	61.8
			17.0		5.8
S 86° W.	56		3.9		56.0

Var. 18 W.

Tr. cour. S68 W. to which and the diſtance 56 m. the difference of latitude is 21 m. and the departure 51.9 m. Hence the latitude in at noon is 36° 47′ W, and middle latitude 36° 58′, to which and the departure 51.9 in a latitude column, the difference of longitude in a diſtance column is 65° W.

Yeſterday's long. by acc.	15° 52′ W.	By obſ.	15° 33′ W.
Difference of longitude	1 5 W.		1 5 W.
Longitude in	16 57		16 38 W.

To find the bearing and diſtance of Porto Sancto.

Latitude ſhip	36° 47′ N	Mer pts	2376	Longitude	16° 38′ W.
Lat. of Porto Sancto	32 58 N	Mer. pts.	2097	Longitude	16 25 W.
Diff. of latitude	3 49 = 229	M.D.Lat.	279	D. Longitude	0 13

Hence the courſe is S¼E, diſtance 229 miles; and the courſe *per* compaſs is S*b*W½W nearly

A Journal from England towards Madeira.

Hours.	Kn.	Fa.	Courſes.	Winds.	Remarks, ☿ October 16. 1793.
1	6		S*b*E.	SW*b*W.	Freſh gales.
2	6	4			
3	7		S.	W.	
4	7				Do. and cloudy.
5	7				
6	7	4			
7	7	6			
8	7				A ſteady freſh gale
9	8		S*b*W.	NW.	
10	8				
11	8				
12	8				Do. weather.
1	8				
2	8				
3	8				
4	9				Do. Weather.
5	9		S*b*W½W.		
6	9			N.	
7	9				Variation *per* amplitude 1½ points W.
8	8	5			
9	9				People employed occaſionally.
10	9			NE*b*E.	
11	7				
12	8				Do. weather. Obſerved ſun's meridian altitude.

Courſe.	Diſt.	D.L.	Dep.	N. Latit. by Acc.	N. Latit. by Obſ.	D.Long.	W. Long. by Acc.	W. Long. by Obſ.	W. Var. Obſ.	Porto Santo's Bearing.	Porto Santo's Diſtance.
S 8° E	186	1 5	26	33° 42′	33° 46′	31′ E.	16° 26′	16° 7′	1½ pts	S 17° W.	50 miles.

Half a point of leeway is allowed on the firſt courſe; which, and the others, are corrected for variation as uſual.

Courſes.	Diſt.	Diff. of latit. N.	Diff. of latit. S.	Departure. E.	Departure. W.
SE*b*S.	12.4		10.3	6.9	
S*b*E½E.	43.		41.2	12.5	
S½E.	65		64.7	6.4	
S.	68.5		68.5		
S8°E.	186		184.7	25.8	

3° 5′

Yeſterday's latitude 36 47 N.

Latitude by account - 33 42 N.

Sum - - 70 29

Middle latitude - 35 15

To middle latitude and the departure, the difference of longitude in a diſtance column is 31′ E.

Yeſterday's lon. by acc. 16 57′ W. by obſ. 16° 38′ W.

Difference of long. 0 31 E. - 31 E.

Longitude in - 16 26 W. - 16 7 W.

To find the bearing and diſtance of Porto Santo.

Latitude ſhip -	33° 46′ N.	Mer. parts -	2155	Longitude -	16° 7′ W.
Lat. Porto Santo	32 58 N.	Mer. parts -	2097	Longitude -	16 25 W.
Difference of latitude	48	Mer. diff lat.	58	Diff. long. -	18

Hence the bearing of Porto Santo is S 17° W, diſtance 50 miles.

A Journal

Ship's Journal.

A Journal from London towards Madeira.

Ship's Journal.

Hours	Kn.	Fa.	Courſes.	Winds.	Remarks, 24 October 17. 1793.
1	5		SSW.	NE*b*E.	Moderate wind and clear.
2	5				Saw the iſland of Porto Sancto, SW*b*S.
3	5		S.		Hauled up to round the eaſt end of Porto Sancto.
4	5				Bent the cables.
5	5				
6	6				
7	6				
8	7				Squally weather.
9	8		SW*b*S.		Porto Sancto W*b*S.
10	7				
11	7		SW*b*W		
12	6				Ditto with rain. Porto Sancto NE.
1	6		SW.		The Deſerters SW*b*S.
2	5				
3	6				
4	7				The Deſerters WSW. 3 or 4 leagues.
5	6				
6			Various.		Hauled up round the eaſt end of the Deſerters.
7					
8			NNW.		Violent ſqualls; clewed upall at times.
9			NW*b*N.		
10					Running into Funchal Roads.
11					
12					Anchored in Funchal Road, with the beſt bower in 30 fathom black ſand and mud. Brazen head E*b*S$\frac{1}{2}$S, Loo Rock NW, the Great Church NNE, and the ſouthermoſt Deſerter SE$\frac{1}{2}$S; off ſhore two-thirds of a mile. Saluted the fort with 13 guns; returned by ditto. Found here his majeſty's ſhip Venus, and 7 Engliſh merchant ſhips.

This journal is performed by inſpection agreeable to the precepts given. Other methods might have been uſed for the ſame purpoſe; for which the two inſtruments already deſcribed and explained ſeem well adapted. We cannot, however, omit recommending the ſliding gunter, which will be found very expeditious, not only in performing a day's work, but alſo in reſolving moſt other nautical problems. See *Sliding Gunter*.

It will be found very ſatisfactory to lay down the ſhip's place on a chart at the noon of each day, and her ſituation with reſpect to the place bound to, and the neareſt land will be obvious. The bearing and diſtance of the intended or any other port, and other requiſites, may be eaſily found by the chart as already explained; and indeed, every days work may be performed on the chart; and thus the uſe of tables ſuperſeded.

EXPLANATION OF THE TABLES.

TABLE I. *To reduce points of the compaſs to degrees, and converſely.*

THE two firſt and two laſt columns of this table contain the ſeveral points and quarter-points of the compaſs; the third column contains the correſponding number of points and quarters; and the fourth, the degrees &c. anſwering thereto. The manner of uſing this table is obvious.

TABLE II. *The miles and parts of a mile in a degree of longitude at every degree of latitude.*

THE firſt column contains degrees of latitude, and the ſecond the correſponding miles in a degree of longitude; the other columns are a continuation of the firſt and ſecond. If the given latitude conſiſts of degrees and minutes, a proportional part of the difference between the miles anſwering to the given and following degrees of latitude is to be ſubtracted from the miles anſwering to the given degree.

EXAMPLE. Required the number of miles in a degree of longitude in latitude 57° 9′?

The difference between the miles anſwering to the latitudes of 57° and 58° is 0.89.

Then as 60′ : 9′ :: 0.89 : 0.13

Miles anſwering to 57° 32.68

Miles anſwering to 57° 9′ 32.55

This table may be uſed in Parallel and Middle Latitude Sailing.

TABLE III. *Of the Sun's Semidiameter.*

This table contains the angle ſubtended by the ſun's ſemidiameter at the earth, for every ſixth day of the year. The months and days are contained in the firſt column, and the ſemidiameter expreſſed in minutes and ſeconds in the ſecond column. It is uſeful in correct-

Explanation of the Tables.

ing altitudes of the sun's limb, and distances between the sun's limb and the moon.

TABLE IV. *Of the Refraction in Altitude.*

THE refraction is necessary for correcting altitudes and distances observed at sea; it is always to be subtracted from the observed altitude, or added to the zenith distance. This table is adapted to a mean state of the atmosphere in Britain, namely, to 29.6 inches of the barometer, and 50° of the thermometer. If the height of the mercury in these instruments be different from the mean, a correction is necessary to reduce the tabular to the true refraction. See REFRACTION.

TABLES V. VI. *Of the Dip of the Horizon.*

THE first of these tables contains the dip answering to a free or unobstructed horizon; and the numbers therein, as well as in the other table, are to be subtracted from the observed altitude, when the fore-observation is used; but added, in the back-observation.

When the sun is over the land, and the ship nearer it than the visible horizon when unconfined: in this case, the sun's limb is to be brought in contact with the line of separation of the sea and land; the distance of that place from the ship is to be found by estimation or otherwise; and the dip answering thereto, and the height of the eye, is to be taken from Table VI.

TABLE VII. *Of the Correction to be applied to the time of high water at full and change of the moon, to find the time of high water on any other day of the moon.*

THE use of this table is fully explained at Section II. Chap I. Book I. of this article.

TABLES VIII. IX. X. *Of the Sun's declination*, &c.

THE first of these tables contains the sun's declination, expressed in degrees, minutes, and tenths of a minute, for four successive years, namely, 1793, 1794, 1795, and 1796: and by means of Table X. may easily be reduced to a future period; observing that, after the 28th of February 1800, the declination answering to the day preceding that given is to be taken.

EXAMPLE I. Required the sun's declination May 1. 1799?

May 1. 1799 is four years after the same day in 1795.

Sun's declination May 1. 1795	-	15° 9′.1 N
Equation from Table X.	- -	+0 0.6
Sun's declination May 1. 1799	-	15 9.7 N

Explanation of the Tables.

EXAMPLE II. Required the sun's declination August 20. 1805?

The given year is 12 years after 1793, and the time is after the end of February 1800.

Now, Sun's dec. August 19. 1793	12° 34′.6
Equation from Table X. to 12 years	—0 1.9
Sun's declination August 20. 1805	12 32.7

The declination in Table VIII. is adapted to the meridian of Greenwich, and Table IX. is intended to reduce it to any other meridian, and to any given time of the day under that meridian. The titles at the top and bottom of this table direct when the reduction is to be added or subtracted.

TABLE XI. *Of the Right Ascensions and Declinations of Fixed Stars.*

This table contains the right ascensions and declinations of 60 principal fixed stars, adapted to the beginning of the year 1793. Columns fourth and sixth contain the annual variation arising from the precession of the equinoxes, and the proper motion of the stars; which serves to reduce the place of a star to a period a few years after the epoch of the table with sufficient accuracy. When the place of a star is wanted, after the beginning of 1793, the variation in right ascension is additive; and that in declination is to be applied according to its sign. The contrary rule is to be used when the given time is before 1793.

EXAMPLE. Required the right ascension and declination of Bellatrix, May 1. 1798?

Right ascension January 1. 1793	=	5h 14′ 3″
Variation = 3″.21×5⅓ y.	=	+0 0 17
Right ascension, May 1. 1798	=	5 14 20
Declination		6° 8′ 53′ N
Variation = 4″×5⅓ y.	=	+0 0 21
Declination May 1. 1798	=	6 9 14 N

The various other tables necessary in the practice of navigation are to be found in most treatises on that subject. Those used in this article are in Mackay's Treatises on the Longitude and Navigation.

TABLE

As the Author of this Article lives at a distance, several ERRATA *have escaped the Press. They are as follow.*

Page 683. col. 1. lines 20. and 22. from bottom. For *Markelyne's*, read *Maskelyne's*.
685. 2. 10. from bottom. For 55′ N. read 55′ S.
686. 1. 25. For N. read S.; and in line 28. for 13° 44′ N. read 18° 6′ S.
687. 1. 7. from bottom. After *measures*, insert 177.
ib. 2. 23. from bottom. After *about*, insert 280.
689. 2. 16. from bottom. After *one*, insert *fourth*; and in line 21. for *where*, read *whose*.
690. 1. 29. For *a*, read *the*.
691. 1. 5. from bottom. After *to*, insert 43° 53′; and in line 29. for *abstracted*, read *subtracted*, and for 8. read 4.
692. 2 2. from bottom. For 73 N, read N 73°.
693. 1. 15. After *be*, insert 281; and in line 17. after *is*, insert 9° 11′ W.
695. 1. 21. from bottom. For *mark*, read *make*.
698. 2. 19. For *on*, read *in*; and in line 20. after 61 dele (°)

TABLE I. *To reduce Points of the Compass to Degrees, and conversely.*

North-east Quadrant.	South-east Quadrant.	Points.	D.	M.	S.	South-west Quadrant.	North-west Quadrant.
North.	South.	0 0	0	0	0	South.	North.
N¼E	S¼E	0 ¼	2	48	45	S¼W	N¼W
N½E	S½E	0 ½	5	37	30	S½W	N½W
N¾E	S¾E	0 ¾	8	26	15	S¾W	N¾W
N*b*E	S*b*E	1 0	11	15	0	S*b*W	N*b*W
N*b*E¼E	S*b*E¼E	1 ¼	14	3	45	S*b*W¼W	N*b*W¼W
N*b*E½E	S*b*E½E	1 ½	16	52	30	S*b*W½W	N*b*W½W
N*b*E¾E	S*b*E¾E	1 ¾	19	41	15	S*b*W¾W	N*b*W¾W
NNE	SSE	2 0	22	30	0	SSW	NNW
NNE¼E	SSE¼E	2 ¼	25	18	45	SSW¼W	NNW¼W
NNE½E	SSE½E	2 ½	28	7	30	SSW½W	NNW½W
NNE¾E	SSE¾E	2 ¾	30	56	15	SSW¾W	NNW¾W
NE*b*N	SE*b*S	3 0	33	45	0	SW*b*S	NW*b*N
NE¾N	SE¾S	3 ¼	36	33	45	SW¾S	NW¾N
NE½N	SE½S	3 ½	39	22	30	SW½S	NW½N
NE¼N	SE¼S	3 ¾	42	11	15	SW¼S	NW¼N
NE	SE	4 0	45	0	0	SW	NW
NE¼E	SE¼E	4 ¼	47	48	45	SW¼W	NW¼W
NE½E	SE½E	4 ½	50	37	30	SW½W	NW½W
NE¾E	SE¾E	4 ¾	53	26	15	SW¾W	NW¾W
NE*b*E	SE*b*E	5 0	56	15	0	SW*b*W	NW*b*W
NE*b*E¼E	SE*b*E¼E	5 ¼	59	3	45	SW*b*W¼W	NW*b*W¼W
NE*b*E½E	SE*b*E½E	5 ½	61	52	30	SW*b*W½W	NW*b*W½W
NE*b*E¾E	SE*b*E¾E	5 ¾	64	41	15	SW*b*W¾W	NW*b*W¾W
ENE	ESE	6 0	67	30	0	WSW	WNW
E*b*N¾N	E*b*S¾S	6 ¼	70	18	45	W*b*S¾S	W*b*N¾N
E*b*N½N	E*b*S½S	6 ½	73	7	30	W*b*S½S	W*b*N½N
E*b*N¼N	E*b*S¼S	6 ¾	75	56	15	W*b*S¼S	W*b*N¼N
E*b*N	E*b*S	7 0	78	45	0	W*b*S	W*b*N
E¾N	E¾S	7 ¼	81	33	45	W¼S	W¾N
E½N	E½S	7 ½	84	22	30	W½S	W½N
E¼N	E¼S	7 ¾	87	11	15	W¼S	W¼N
East.	East.	8 0	90	0	0	West.	West.

TABLE II. *The Miles and Parts of a Mile in a Degree of Longitude at every Degree of Latitude.*

D.L.	Miles.	D.L.	Miles.	D.L.	Miles.	D.L.	Miles.	D.L.	Miles.	D.L.	Miles.
1	59.99	16	57.67	31	51.43	46	41.68	61	29.09	76	14.51
2	59.97	17	57.36	32	50.88	47	40.92	62	28.17	77	13.50
3	59.92	18	57.06	33	50.32	48	40.15	63	27.24	78	12.48
4	59.86	19	56.73	34	49.74	49	39.36	64	26.30	79	11.45
5	59.77	20	56.38	35	49.15	50	38.57	65	25.36	80	10.42
6	59.67	21	56.01	36	48.54	51	37.76	66	24.41	81	9.38
7	59.56	22	55.63	37	47.92	52	36.94	67	23.45	82	8.35
8	59.44	23	55.23	38	47.28	53	36.11	68	22.48	83	7.32
9	59.26	24	54.81	39	46.62	54	35.26	69	21.50	84	6.28
10	59.08	25	54.38	40	45.95	55	34.41	70	20.52	85	5.23
11	58.89	26	53.93	41	45.28	56	33.55	71	19.54	86	4.18
12	58.68	27	53.46	42	44.95	57	32.68	72	18.54	87	3.14
13	58.46	28	52.97	43	43.88	58	31.79	73	17.54	88	2.09
14	58.22	29	52.47	44	43.16	59	30.90	74	16.53	89	1.05
15	57.95	30	51.96	45	42.43	60	30.00	75	15.52	90	0.00

TABLE III. *The Sun's Semidia.*

Mon.	Day	Sun's Semidiam.	
January.	1	16′	19″
	7	16	19
	13	16	19
	19	16	18
	25	16	17
February.	1	16	16
	7	16	15
	13	16	14
	19	16	13
	25	16	12
March.	1	16	10
	7	16	9
	13	16	7
	19	16	6
	25	16	4
April.	1	16	2
	7	16	1
	13	15	59
	19	15	57
	25	15	56
May.	1	15	54
	7	15	53
	13	15	52
	19	15	51
	25	15	50
June.	1	15	49
	7	15	48
	13	15	47
	19	15	47
	25	15	47
July.	1	15	47
	7	15	47
	13	15	47
	19	15	48
	25	15	48
August.	1	15	49
	7	15	50
	13	15	51
	19	15	52
	25	15	53
September.	1	15	55
	7	15	56
	13	15	58
	19	15	59
	25	16	1
October.	1	16	3
	7	16	4
	13	16	6
	19	16	8
	25	16	9
November.	1	16	11
	7	16	13
	13	16	14
	19	16	15
	25	16	16
December.	1	16	17
	7	16	18
	13	16	18
	19	16	19
	25	16	19

TABLE IV.
Refraction in Altitude.

App. Alt.	Refrac.	App. Alt.	Refrac.	App Alt.	Refrac.
D. M.	M. S.	D. M.	M S	D.	M. S.
0 0	33 0	6 30	7 51	30	1 38
0 5	32 10	6 40	7 40	31	1 35
0 10	31 22	6 50	7 30	32	1 31
0 15	30 35	7 0	7 20	33	1 28
0 20	29 50	7 10	7 11	34	1 24
0 25	29 6	7 20	7 2	35	1 21
0 30	28 22	7 30	6 53	36	1 18
0 35	27 41	7 40	6 45	37	1 16
0 40	27 0	7 50	6 37	38	1 13
0 45	26 20	8 0	6 29	39	1 10
0 50	25 42	8 10	6 22	40	1 8
0 55	25 5	8 20	6 15	41	1 5
1 0	24 49	8 30	6 8	42	1 3
1 5	23 54	8 40	6 1	43	1 1
1 10	23 20	8 50	5 55	44	0 59
1 15	22 47	9 0	5 48	45	0 57
1 20	22 15	9 10	5 42	46	0 55
1 25	21 44	9 20	5 36	47	0 53
1 30	21 15	9 30	5 31	48	0 51
1 35	20 46	9 40	5 25	49	0 49
1 40	20 18	9 50	5 20	50	0 48
1 45	19 51	10 0	5 15	51	0 46
1 50	19 25	10 15	5 7	52	0 44
1 55	19 0	10 30	5 0	53	0 43
2 0	18 35	10 45	4 53	54	0 41
2 5	18 11	11 0	4 47	55	0 40
2 10	17 48	11 15	4 40	56	0 38
2 15	17 26	11 30	4 34	57	0 37
2 20	17 4	11 45	4 29	58	0 35
2 25	16 44	12 0	4 23	59	0 34
2 30	16 24	12 20	4 16	60	0 33
2 35	16 4	12 40	4 9	61	0 32
2 40	15 45	13 0	4 3	62	0 30
2 45	15 27	13 20	3 57	63	0 29
2 50	15 9	13 40	3 51	64	0 28
2 55	14 52	14 0	3 45	65	0 26
3 0	14 36	14 20	3 40	66	0 25
3 5	14 20	14 40	3 35	67	0 24
3 10	14 4	15 0	3 30	68	0 23
3 15	13 49	15 30	3 24	69	0 22
3 20	13 34	16 0	3 17	70	0 21
3 25	13 20	16 30	3 10	71	0 19
3 30	13 6	17 0	3 4	72	0 18
3 40	12 40	17 30	2 59	73	0 17
3 50	12 15	18 0	2 54	74	0 16
4 0	11 51	18 30	2 49	75	0 15
4 10	11 29	19 0	2 44	76	0 14
4 20	11 8	19 30	2 39	77	0 13
4 30	10 48	20 0	2 35	78	0 12
4 40	10 29	20 30	2 31	79	0 11
4 50	10 11	21 0	2 27	80	0 10
5 0	9 54	21 30	2 24	81	0 9
5 10	9 38	22 0	2 20	82	0 8
5 20	9 23	23 0	2 14	83	0 7
5 30	9 8	24 0	2 7	84	0 6
5 40	8 54	25 0	2 2	85	0 5
5 50	8 41	26 0	1 56	86	0 4
6 0	8 28	27 0	1 51	87	0 3
6 10	8 15	28 0	1 47	88	0 2
6 20	8 3	29 0	1 42	89	0 1

TABLE V.
Dip of the Horizon.

Height of eye.	Dip. of Horizon	Height of eye	Dip. of Horizon.	Height of eye.	Dip. of Horizon.	Height of eye.	Dip. of Horizon
Feet.	M. S.	Feet.	M. S.	Feet.	M. S.	Feet.	M. S.
1	0 57	11	3 10	21	4 22	35	5 39
2	1 21	12	3 18	22	4 28	40	6 2
3	1 39	13	3 26	23	4 34	45	6 24
4	1 55	14	3 34	24	4 40	50	6 44
5	2 8	15	3 42	25	4 46	55	7 4
6	2 20	16	3 49	26	4 52	60	7 23
7	2 31	17	3 56	27	4 58	70	7 59
8	2 42	18	4 3	28	5 3	80	8 32
9	2 52	19	4 10	29	5 9	90	9 3
10	3 1	20	4 16	30	5 14	100	9 33

TABLE VI.
Dip of the Sea at different distances from the Observer.

Dist. of land in sea miles.	Height of the eye above the sea in feet.							
	5	10	15	20	25	30	35	40
	Dip.	Dip.	Dip.	Dip.	Dip.	Dip.	Dip.	Dip.
	M.	M.	M.	M.	M.	M.	M.	M.
0 0 ¼	11	22	34	45	56	68	79	90
0 ½	6	11	17	22	28	34	39	45
0 ¾	4	8	12	15	19	23	27	30
1 0	4	6	9	12	15	17	20	23
1 ¼	3	5	7	9	12	14	16	19
1 ½	3	4	6	8	10	11	14	15
2 0	2	3	5	6	8	10	11	12
2 ½	2	3	5	6	7	8	9	10
3 0	2	3	4	5	6	7	8	8
3 ½	2	3	4	5	6	6	7	7
4 0	2	3	4	4	5	6	7	7
5 0	2	3	4	4	5	5	6	6
6 0	2	3	4	4	5	5	6	6

TABLE VII.
The Correction to be applied to the Time of High-water at Full and Change of the Moon, to find the time of High-water on any other day.

Interval of Time.	After New or Full Moon	Before 1st or 3d Quarter.	After 1st or 3d Quarter	Before New or Full Moon
	Additive.	Additive.	Additive.	Subtractive.
D. H.	H M.	H. M	H. M.	H. M.
0 0	0 0	5 6	5 6	0 0
0 6	0 8	4 51	5 22	0 9
0 12	0 17	4 37	5 40	0 18
0 18	0 26	4 23	6 0	0 27
1 0	0 36	4 9	6 20	0 37
1 6	0 45	3 56	6 39	0 47
1 12	0 54	3 44	6 58	0 57
1 18	1 2	3 32	7 18	1 7
2 0	1 11	3 21	7 37	1 17
2 6	1 19	3 11	7 56	1 28
2 12	1 28	3 1	8 14	1 39
2 18	1 37	2 50	8 31	1 51
3 0	1 46	2 40	8 47	2 4
3 6	1 54	2 30	9 2	2 16
3 12	2 3	2 21	9 17	2 29
3 18	2 12	2 12	9 31	2 44
4 0	2 21	2 3	9 44	2 58

TABLE VIII. *Sun's Declination for* 1793, *being the first after leap year.*

Days	January	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	22° 57′1 S.	16° 52′3 S.	7° 17′0 S.	4° 49′9 N	15° 17′8 N	22° 9′6 N	23° 5′3 N	17° 52′6 N	8° 3′0 N	3° 27′7 S.	14° 41′1 S.	21° 56′9 S.
2	22 51.5	16 34.8	6 54.1	5 12.9	15 35.6	22 17.3	23 0.8	17 37.2	7 41.0	3 51.0	15 0.1	22 5.7
3	22 45.5	16 17.1	6 31.1	5 35.8	15 53.2	22 24.7	22 56.0	17 21.4	7 18.9	4 14.3	15 18.9	22 14.1
4	22 39.0	15 59.0	6 8.0	5 58.7	16 10.5	22 31.6	22 50.7	17 5.4	6 56.7	4 37.5	15 37.4	22 22.0
5	22 32.1	15 40.7	5 44.8	6 21.4	16 27.5	22 38.1	22 45.0	16 49.1	6 34.4	5 0.7	15 55.6	22 29.5
6	22 24.7	15 22.1	5 21.6	6 44.0	16 44.3	22 44.3	22 38.9	16 32.5	6 11.9	5 23.8	16 13.6	22 36.6
7	22 16.9	15 3.3	4 58.2	7 6.6	17 0.9	22 50.0	22 32.4	16 15.7	5 49.4	5 46.8	16 31.2	22 43.2
8	22 8.6	14 44.2	4 34.8	7 28.9	17 17.1	22 55.4	22 25.6	15 58.5	5 26.8	6 9.7	16 48.7	22 49.4
9	21 59.9	14 24.8	4 11.4	7 51.2	17 33.0	23 0.3	22 18.3	15 41.2	5 4.0	6 32.6	17 5.8	22 55.1
10	21 50.8	14 5.2	3 47.9	8 13.3	17 48.7	23 4.9	22 10.7	15 23.5	4 41.2	6 22.4	17 22.6	23 0.4
11	21 41.3	13 45.4	3 24.3	8 35.3	18 4.0	23 9.0	22 2.7	15 5.7	4 18.3	7 18.0	17 39.1	23 5.2
12	21 31.3	13 25.4	3 0.7	8 57.2	18 19.1	23 12.7	21 54.3	15 47.6	3 55.4	7 40.6	17 55.3	23 9.6
13	21 20.9	13 5.1	2 37.0	9 18.9	18 33.8	23 16.0	21 45.5	14 29.2	3 32.3	8 3.1	18 11.2	23 13.5
14	21 10.8	12 44.6	2 13.4	9 40.4	18 48.2	23 18.9	21 36.3	14 10.7	3 9.2	8 25.4	18 26.8	23 16.9
15	20 58.9	12 23.9	1 49.7	10 1.8	19 2.3	23 21.4	21 26.8	13 51.9	2 46.1	8 47.7	18 42.1	23 19.9
16	20 47.3	12 3.1	1 26.0	10 23.1	19 16.1	23 23.5	21 17.0	13 32.9	2 22.9	9 9.8	18 57.0	23 22.4
17	20 35.4	11 42.0	1 2.3	10 44.1	19 29.6	23 25.2	21 6.7	13 13.6	1 59.6	9 31.7	19 11.6	23 24.4
18	20 23.0	11 20.8	0 38.6	11 5.0	19 42.7	23 26.5	20 56.1	12 54.2	1 36.4	9 53.6	19 25.8	23 26.0
19	20 10.2	10 59.4	0 14.9 S.	11 25.7	19 55.5	23 27.3	20 45.2	12 34.6	1 13.0	10 15.3	19 39.7	23 27.0
20	19 57.1	10 37.8	0 8.7 N.	11 46.2	20 8.0	23 27.7	20 33.9	12 14.7	0 49.7	10 36.8	19 53.2	23 27.7
21	19 43.6	10 16.3	0 32.4	12 6.5	20 20.1	23 27.8	20 22.3	11 54.7	0 26.3	10 58.2	20 6.4	23 27.8
22	19 29.7	9 54.1	0 56.0	12 26.6	20 31.9	23 27.3	20 10.3	11 34.5	0 2.9 N	11 19.4	20 19.2	23 27.5
23	19 15.5	9 32.1	1 19.7	12 46.5	20 43.3	23 26.6	19 58.0	11 14.1	0 20.5 S	11 40.4	20 31.6	23 26.7
24	19 0.9	9 9.9	1 43.2	13 6.2	20 54.3	23 25.3	19 45.3	10 53.5	0 43.9	12 1.3	20 43.7	23 25.4
25	18 46.0	8 47.6	2 6.8	13 25.7	21 5.0	23 23.7	19 32.3	10 32.7	1 7.4	12 22.0	20 55.3	23 23.7
26	18 30.7	8 25.1	2 30.2	13 44.9	21 15.4	23 21.7	19 19.0	10 11.8	1 30.8	12 42.5	21 6.6	23 21.5
27	18 15.1	8 2.6	2 53.7	14 4.0	21 25.3	23 19.2	19 5.4	9 50.7	1 54.2	13 2.8	21 17.5	23 18.8
28	17 59.2	7 39.9	3 17.1	14 22.8	21 34.9	23 16.4	18 51.5	9 29.5	2 17.6	13 22.9	21 27.9	23 15.6
29	17 42.9		3 40.4	14 41.3	21 44.2	23 13.1	18 37.2	9 8.1	2 41.0	13 42.8	21 38.0	23 12.0
30	17 26.4		4 3.6	14 59.7	21 53.0	23 9.4	18 22.6	8 46.5	3 4.4	14 2.5	21 47.6	23 7.9
31	17 9.5		4 26.8		22 1.5		18 7.8	8 24.8		14 21.9		23 3.4

TABLE VIII. *Sun's Declination for* 1794, *being the second after leap year.*

Days	January.	February.	March.	April.	May.	June.	July.	August	September.	October.	November.	December.
1	22° 58′4 S.	16° 56′5 S.	7° 22′6 S.	4° 44′3 N	15° 13′0 N	22° 7′7 N	23° 6.4 N	17° 56′3 N	8° 8′2 N	3° 22′2 S.	14° 36′5 S.	21° 54′7 S
2	22 52.9	16 39.1	6 59.7	5 7.4	15 31.3	22 15.5	23 2.0	17 40.9	7 46.3	3 45.5	14 55.6	22 3.6
3	22 47.0	16 21.4	6 36.7	5 30.4	15 49.0	22 23.0	22 57.2	17 25.2	7 24.2	4 8.7	15 14.3	22 12.1
4	22 40.6	16 3.4	6 13.6	5 53.2	16 6.4	22 30.0	22 52.0	17 9.2	7 2.1	4 31.9	15 32.9	22 20.1
5	22 33.8	15 45.1	5 50.4	6 16.0	16 23.5	22 36.6	22 46.4	16 53.0	6 39.8	4 55.1	15 51.2	22 27.7
6	22 26.5	15 26.6	5 27.2	6 38.6	16 40.3	22 42.8	22 40.4	16 36.5	6 17.4	5 18.1	16 9.2	22 34.9
7	22 18.8	15 7.8	5 3.8	7 1.2	16 56.9	22 48.7	22 34.0	16 19.7	5 54.9	5 41.2	16 26.9	22 46.6
8	22 10.7	14 48.8	4 40.5	7 23.6	17 13.2	22 54.1	22 27.3	16 2.7	5 32.3	6 4.1	16 44.4	22 47.9
9	22 2.1	14 29.5	4 17.0	7 45.8	17 29.2	22 59.2	22 20.1	15 45.4	5 9.6	6 27.0	17 1.6	22 53.7
10	21 53.1	14 10.0	3 53.5	8 8.0	17 44.9	23 3.8	22 12.6	15 27.9	4 46.8	6 49.7	17 18.4	22 59.1
11	21 43.6	13 50.2	3 30.0	8 30.0	18 0.3	23 8.0	22 4.7	15 10.1	4 24.0	7 12.4	17 35.0	23 4.1
12	21 33.8	13 30.3	3 6.4	8 51.9	18 15.4	23 11.9	21 56.4	14 52.1	4 1.0	7 35.0	17 51.3	23 8.5
13	21 23.5	13 10.1	2 42.8	9 13.6	18 30.2	23 15.3	21 47.7	14 33.8	3 38.0	7 57.5	18 7.3	23 12.5
14	21 12.8	12 49.7	2 19.2	9 35.2	18 44.7	23 18.3	21 38.6	14 15.3	3 15.0	8 19.9	18 23.0	23 16.1
15	21 1.7	12 29.1	1 55.5	9 56.6	18 58.9	23 20.9	21 29.2	13 56.5	2 51.8	8 42.2	18 38.3	23 19.2
16	20 50.2	12 8.2	1 31.8	10 17.8	19 12.8	23 23.1	21 19.4	13 37.6	2 28.6	9 4.3	18 53.3	23 21.8
17	20 38.4	11 47.2	1 8.2	10 38.9	19 26.3	23 24.8	21 9.3	13 18.4	2 5.4	9 26.3	19 8.0	23 23.9
18	20 26.1	11 26.1	0 44.5	10 59.8	19 39.5	23 26.2	20 58.8	12 59.0	1 42.1	9 48.2	19 22.3	23 25.6
19	20 13.4	11 4.7	0 20.8 S.	10 20.6	19 52.4	23 27.2	20 47.9	12 39.4	1 18.8	10 9.9	19 36.3	23 26.8
20	20 0.4	10 43.1	0 2.9 N	11 41.1	20 4.9	23 27.7	20 36.7	12 19.6	0 55.4	10 31.5	19 50.0	23 27.6
21	19 47.0	10 21.4	0 26.5	12 1.5	20 17.1	23 27.8	20 25.2	11 59.6	0 32.0	10 53.0	20 3.2	23 27.8
22	19 33.2	9 59.6	0 50.2	12 21.6	20 29.0	23 27.5	20 13.2	11 39.4	0 8.6 N	11 14.2	20 16.1	23 27.6
23	19 19.0	9 37.5	1 13.8	12 41.6	20 40.5	23 26.8	20 1.0	11 19.0	0 14.8 S	11 35.3	20 28.6	23 26.9
24	19 4.5	9 15.4	1 37.4	13 1.4	20 51.6	23 25.7	19 48.4	10 58.5	0 38.3	11 56.3	20 40.8	23 25.1
25	18 49.7	8 53.1	2 1.0	13 20.9	21 2.4	23 24.2	19 35.5	10 37.8	1 1.7	12 17.0	20 52.6	23 24.2
26	18 34.5	8 30.6	2 24.5	13 40.2	21 12.9	23 22.2	19 22.3	10 16.8	1 25.2	12 37.6	21 3.9	23 22.1
27	18 18.9	8 8.1	2 47.9	13 59.3	21 23.0	23 19.9	19 8.7	9 55.8	1 48.6	12 57.9	21 14.9	23 19.5
28	18 3.1	7 45.4	3 11.4	14 18.2	21 32.7	23 17.1	18 54.8	9 34.6	2 12.0	13 18.1	21 25.5	23 16.5
29	17 46.9		3 34.7	14 36.9	21 42.0	23 13.9	18 40.7	9 13.2	2 35.4	13 38.0	21 35.6	23 13.0
30	17 30.4		3 58.0	14 55.2	21 50.9	23 10.4	18 26.2	8 51.7	2 58.8	13 57.8	21 45.4	23 9.0
31	17 13.6		4 21.2		21 59.5		18 11.4	8 30.0		14 17.3		23 4.6

TABLE

TABLE VIII. *Sun's Declination for* 1795, *being the third after leap year.*

Days.	January.	February.	March.	April	May.	June.	July.	August.	September.	October.	November.	December.
1	22° 59'7 S	17° 0'7 S	7° 28'1 S	4° 38'8 N	15° 9'1 N	22° 5'8 N	23° 7'4 N	18° 0'0 N	8° 13'5 N	3° 16'4 S	14° 31'8 S	21° 52'4 S
2	22 54.3	16 43.4	7 5.3	5 1.8	15 27.1	22 13.7	23 3.1	17 44.7	7 51.7	3 39.7	14 50.9	21 1.4
3	22 48.5	16 25.8	6 42.3	5 24.8	15 44.8	22 21.2	22 58.4	17 29.1	7 29.6	4 3.0	15 9.7	22 10.0
4	22 42.3	16 7.9	6 19.3	5 47.7	16 2.2	22 28.3	22 53.3	17 13.2	7 7.5	4 26.2	15 28.3	22 18.2
5	22 35.5	15 49.7	5 56.1	6 10.4	16 19.4	22 35.0	22 47.8	16 57.0	6 45.2	4 49.4	15 46.7	22 25.9
6	22 28.4	15 31.3	5 32.9	6 33.1	16 36.3	22 41.4	22 42.0	16 40.6	6 22.9	5 12.5	16 4.8	22 33.2
7	22 20.8	15 12.5	5 9.6	6 55.6	16 52.9	22 47.3	22 35.7	16 23.9	6 0.4	5 35.5	16 22.6	22 40.0
8	22 12.8	14 53.6	4 46.3	7 18.1	17 9.3	22 52.9	22 29.0	16 6.9	5 37.8	5 58.5	16 40.1	22 46.4
9	22 4.3	14 34.4	4 22.8	7 40.4	17 25.3	22 58.0	22 21.9	15 49.7	5 15.1	6 21.4	16 57.4	22 52.4
10	21 55.4	14 14.9	3 59.4	8 2.6	17 41.1	23 2.7	22 14.5	15 32.2	4 52.4	6 44.2	17 14.4	22 57.9
11	21 46.0	13 55.2	3 35.8	8 24.6	17 56.6	23 7.1	22 6.7	15 14.4	4 29.5	7 6.9	17 31.0	23 2.9
12	21 36.3	13 35.3	3 12.3	8 46.5	18 11.8	23 11.0	21 58.4	14 56.4	4 6.6	7 29.6	17 47.4	23 7.5
13	21 26.1	13 15.1	2 48.6	9 8.3	18 26.7	23 14.5	21 49.8	14 38.2	3 43.6	7 52.1	18 3.5	23 11.7
14	21 15.5	12 54.8	2 25.0	9 29.9	18 41.3	23 17.6	21 40.9	14 19.7	3 20.5	8 14.5	18 19.2	23 15.3
15	21 4.5	12 34.2	2 1.3	9 51.4	18 55.6	23 20.3	21 31.5	14 1.0	2 57.4	8 36.8	18 34.7	23 18.5
16	20 53.1	12 13.4	1 37.7	10 12.7	19 9.5	23 22.6	21 21.9	13 42.1	2 34.2	8 59.0	18 49.8	23 21.2
17	20 41.3	11 52.4	1 13.9	10 33.9	19 24.1	23 24.5	21 11.8	13 23.0	2 10.9	9 21.1	19 4.5	23 23.5
18	20 29.2	11 31.3	0 50.2	10 54.8	19 36.4	23 25.9	21 1.3	13 3.6	1 47.6	9 43.0	19 18.9	23 25.3
19	20 16.6	11 9.9	0 26.5	11 15.6	19 49.4	23 27.0	20 50.6	12 44.1	1 24.3	10 4.8	19 33.0	23 26.6
20	20 3.6	10 48.4	0 2.8 S	11 36.2	20 2.0	23 27.6	20 39.4	12 24.3	1 0.9	10 26.4	19 46.7	23 27.5
21	19 50.3	10 26.7	0 20.8 N	11 56.7	20 14.3	23 27.9	20 27.9	12 4.4	0 37.6	10 47.8	20 0.1	23 27.9
22	19 36.6	10 4.9	0 44.5	12 16.9	20 26.2	23 27.7	20 16.1	11 44.2	0 14.2 N	11 9.1	20 13.1	23 27.8
23	19 22.5	9 42.9	1 8.1	12 36.9	20 37.8	23 27.0	20 4.0	11 23.9	0 9.2 S	11 30.3	20 25.7	23 27.2
24	19 8.1	9 20.7	1 31.8	12 56.7	20 49.1	23 26.0	19 51.5	11 3.4	0 32.7	11 51.2	20 37.9	23 26.2
25	18 53.3	8 58.5	1 55.3	13 16.3	21 0.0	23 24.6	19 38.6	10 42.7	0 56.1	12 12.0	20 49.7	23 24.6
26	18 38.2	8 36.1	2 18.9	13 35.7	21 10.5	23 22.7	19 25.5	10 21.9	1 19.5	12 32.6	21 1.2	23 22.7
27	18 22.8	8 13.5	2 42.3	13 54.8	21 20.6	23 20.5	19 12.0	10 0.9	1 42.9	12 53.0	21 12.2	23 20.2
28	18 7.0	7 50.9	3 5.8	14 13.8	21 30.4	23 17.8	18 58.2	9 39.7	2 6.3	13 13.2	21 22.9	23 17.3
29	17 50.9		3 29.1	14 32.5	21 39.8	23 14.8	18 44.1	9 18.4	2 29.7	13 33.2	21 33.1	23 13.9
30	17 34.5		3 52.4	14 50.9	21 48.9	23 11.3	18 29.7	8 56.9	2 53.1	13 52.9	21 43.0	23 10.1
31	17 17.7		4 15.6		21 57.5		18 15.0	8 35.3		14 12.		

TABLE VIII. *Sun's Declination for* 1796, *being leap year.*

Days.	January.	February.	March.	April.	May.	June	July.	August.	September.	October.	November.	December.
1	23° 1'0 S	17° 5 0 S	7° 11'0 S	4° 56'1 N	15° 22 7 N	22° 11'8 N	23° 4'2 N	17° 48'5 N	7° 57'0 N	3° 34'1 S	14° 46'4 S	21° 59'4 S
2	22 55.7	16 47.8	6 48.0	5 19.1	15 40.5	22 19.5	22 59.6	17 32.9	7 35.0	3 57.4	15 5.3	22 8.1
3	22 50.0	16 30.2	6 25.0	5 42.1	15 58.0	22 26.7	22 54.6	17 17.1	7 12.9	4 20.6	15 24.0	22 16.3
4	22 43.9	16 12.4	6 1.9	6 4.9	16 15.2	22 33.5	22 49.2	17 1.0	6 50.6	4 43.8	15 42.4	22 24.2
5	22 37.3	15 54.2	5 38.6	6 27.6	16 32.2	22 39.9	22 43.4	16 44.6	6 28.3	5 7.0	16 0.5	22 31.6
6	22 30.2	15 35.8	5 15.4	6 50.2	16 49.0	22 46.0	22 37.3	16 27.9	6 5.8	5 30.0	16 18.4	22 38.5
7	22 22.7	15 17.2	4 52.0	7 12.7	17 5.4	22 51.6	22 30.7	16 11.0	5 43.2	5 53.0	16 36.0	22 45.0
8	22 14.8	14 58.3	4 28.6	7 35.0	17 21.6	22 56.9	22 23.7	15 53.8	5 20.6	6 16.0	16 53.3	22 51.1
9	22 6 4	14 39.1	4 5.1	7 57.3	17 37.4	23 1.7	22 16.3	15 36.4	4 57.8	6 38.8	17 10.4	22 56.7
10	21 57.6	14 19.7	3 41.5	8 19.4	17 53.0	23 6.1	22 8.6	15 18.7	4 35.0	7 1.5	17 27.1	23 1.8
11	21 48.4	14 0.0	3 18.0	8 41.3	18 8.2	23 10.1	22 0.5	15 0.8	4 12.1	7 24.2	17 43.6	23 6.5
12	21 38.7	13 40.1	2 54.3	9 3.1	18 23.2	23 13.8	22 52.0	14 42.6	3 49.1	7 46.7	17 59.7	23 10.7
13	21 28.7	13 20.0	2 30.7	9 24.8	18 37.9	23 17.0	21 43.1	14 24.2	3 26.1	8 9.1	18 15.5	23 14.5
14	21 18.2	12 59.7	2 7.0	9 46.3	18 52.2	23 19.8	21 33.9	14 5.6	3 3.0	8 31.5	18 31.0	23 17.8
15	21 7.3	12 39.2	1 43.4	10 7.7	19 6.2	23 22.1	21 24.2	13 46.8	2 39.8	8 53.6	18 46.2	23 20.7
16	20 56.0	12 18.5	1 19.7	10 28.8	19 19.9	23 24.1	21 14.3	13 27.7	2 16.6	9 15.7	19 1.0	23 23.0
17	20 44.3	11 57.5	0 56.0	10 49.8	19 33.3	23 25.7	21 3.9	13 8.4	1 53.3	9 37.6	19 15.5	23 24.9
18	20 32.2	11 36.4	0 32.3	11 10.7	19 46.3	23 26.8	20 53.3	12 48.9	1 30.1	9 59.4	19 29.6	23 26.4
19	20 19.7	11 15.2	0 8.6 S	11 31.3	19 59.0	23 27.5	20 42.2	12 29.2	1 6.7	10 21.1	19 43.4	23 27.3
20	20 6.9	10 53.7	0 15.1 N	11 51.7	20 11.4	23 27.9	20 30.8	12 9.3	0 43.3	10 42.6	19 56.9	23 27.8
21	19 53.6	10 32.1	0 38.7	12 12.0	20 23.4	23 27.8	20 19.1	11 49.3	0 20.0 N	11 3.9	20 9.9	23 27.9
22	19 40.0	10 10.3	1 2.4	12 32.0	20 35.1	23 27.3	20 7.0	11 29.0	0 3.4 S	11 25.1	20 22.6	23 27.4
23	19 26.1	9 48.4	1 26.0	12 51.9	20 46.4	23 26.3	19 54.6	11 8.5	0 26.9	11 46.1	20 35.0	23 26.5
24	19 11.7	9 26.3	1 49.5	13 11.5	20 57.4	23 25.0	19 41.9	10 47.9	0 50.3	12 7.0	20 46.9	23 25.1
25	18 57.1	9 4.0	2 13.1	13 30.9	21 8.0	23 23.3	19 28.8	10 27.1	1 13.7	12 27.6	20 58.5	23 23.2
26	18 42.0	8 41.7	2 36.6	13 50.2	21 18.2	23 21.1	19 15.4	10 6.1	1 37.2	12 48.0	21 9.6	23 20.9
27	18 26.7	8 19.2	3 0.0	14 9.1	21 28.5	23 18.6	19 1.7	9 45.0	2 0.6	13 8.3	21 20.4	23 18.1
28	18 11.0	7 56.6	3 23.3	14 27.9	21 37.6	23 15.6	18 47.6	9 23.7	2 24.0	13 28.4	21 30.8	23 14.8
29	17 55.0	7 33.8	3 46.6	14 46.4	21 46.7	23 12.2	18 33.3	9 2.2	2 47.4	13 48.2	21 40.7	23 11.1
30	17 38.6		4 9.9	15 4.7	21 55.5	23 8.4	18 18.6	8 40.6	3 10.8	14 7.8	21 50.3	23 6.8
31	17 22.0		4 33.0		22 3.8		18 3.7	8 18.9		14 27.2		23 2.2

TABLE

TABLE IX. To reduce the Sun's Declination to any other Meridian, and to any given Time under that Meridian.

Add in W. Sub. in E.	Sub. in W. Add in E.	LONGITUDE. 10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°	130°	140°	150°	160°	170°	180°	Add in W. Sub. in E.	Sub. in W. Add in E.
December. 21	December. 21	0'0	0 0	0'0	0 0	0 0	0 0	0'0	0 0	0 0	0 0	0'0	0'0	0'0	0'0	0 0	0'0	0 0	0'0	21	21
20	22	0·0	0.0	0.0	0·0	0·0	0.1	0.1	0.1	0·1	0.1	0·1	0·1	0·2	0.2	0·2	0.2	0.2	0.2	20	22
19	23	0·0	0.0	0.1	0·1	0·1	0.1	0.2	0.2	0·2	0.3	0·3	0·3	0·3	0.3	0·4	0 4	0.4	0.4	19	23
18	24	0·0	0.1	0.1	0·1	0·2	0.2	0.2	0.3	0·3	0.4	0·4	0.4	0·5	0.5	0·5	0.6	0 6	0.6	18	24
17	25	0·1	0.1	0.1	0·2	0·2	0.3	0.3	0.4	0·4	0.5	0·5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	17	25
16	26	0·1	0.1	0.2	0.2	0·3	0.4	0.4	0.5	0·5	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	16	26
15	27	0·1	0.1	0.2	0.3	0·4	0.4	0.5	0.6	0·7	0.8	0.8	0.9	0.9	1.0	1.1	1.2	1.2	1.3	15	27
14	28	0.1	0.2	0.2	0.3	0·4	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.1	1.2	1.3	1.4	1.4	1.5	14	28
13	29	0.1	0.2	0.3	0.4	0·5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	13	29
12	30	0.1	0.2	0.3	0.4	0·5	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.9	2.0	12	30
11	31	0.1	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.5	1.6	1.7	1.8	1.9	2.1	2.2	11	1
10	1	0.1	0.3	0.4	0.5	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.6	1.7	1.9	2.0	2.2	2.3	2.4	10	2
9	2	0.1	0.3	0.4	0.6	0.7	0.9	1.0	1.2	1.3	1.5	1.6	1.8	1.9	2.0	2.2	2.3	2.5	2.6	9	3
8	3	0.1	0.3	0.5	0.6	0.8	0.9	1.1	1.3	1.4	1.6	1.7	1.9	2.1	2.2	2.4	2.5	2.7	2.8	8	4
7	4	0.2	0.3	0.5	0.7	0.8	1.0	1.2	1.4	1.5	1.7	1.9	2.0	2.2	2.4	2.6	2.7	2.9	3.1	7	5
6	5	0.2	0.4	0.5	0.7	0.9	1.1	1.3	1.4	1.6	1.8	2.0	2.2	2.4	2.5	2.7	2.9	3.1	3.3	6	6
5	6	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.5	5	7
4	7	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.3	2.5	2.7	2.9	3.1	3.3	3.5	3.7	4	8
3	8	0.2	0.4	0.6	0.9	1.1	1.3	1.5	1.7	1.9	2.2	2.4	2.6	2.8	3.0	3.2	3.5	3.7	3.9	3	9
2	9	0.2	0.4	0.7	0.9	1.1	1.4	1.6	1.8	2.0	2.3	2.5	2.7	3.0	3.2	3.4	3.6	3.9	4.1	2	10
1	10	0.2	0.5	0.7	0.9	1.2	1.4	1.7	1.9	2.1	2.4	2.6	2.9	3.1	3.3	3.6	3.8	4.1	4.3	1	11
30	11	0.2	0.5	0.7	1.0	1.2	1.5	1.7	2.0	2.2	2.5	2.7	3.0	3.2	3.5	3.7	4.0	4.2	4.5	31	12
29	12	0.3	0.5	0.8	1.0	1.3	1.6	1.8	2.1	2.3	2.6	2.9	3.1	3.4	3.6	3.9	4.2	4.4	4.7	30	13
28	13	0.3	0.5	0.8	1.1	1.4	1.6	1.9	2.2	2.4	2.7	3.0	3.3	3.5	3.8	4.1	4.3	4.6	4.9	29	14
27	14	0.3	0.6	0.8	1.1	1.4	1.7	2.0	2.3	2.5	2.8	3.1	3.4	3.7	4.0	4.2	4.5	4.8	5.1	28	15
26	15	0.3	0.6	0.9	1.2	1.5	1.8	2.0	2.3	2.6	2.9	3.2	3.5	3.8	4.1	4.4	4.7	5.0	5.3	27	16
25	16	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.3	3.6	3.9	4.3	4.6	4.9	5.2	5.5	26	17
24	17	0.3	0.6	0.9	1.3	1.6	1.9	2.2	2.5	2.8	3.1	3.5	3.8	4.1	4.4	4.7	5.0	5.3	5.7	25	18
23	18	0.3	0.6	1.0	1.3	1.6	1.9	2.3	2.6	2.9	3.2	3.6	3.9	4.2	4.5	4.9	5.2	5.5	5.8	24	19
22	19	0.3	0.7	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0	4.3	4.7	5.0	5.4	5.7	6.0	23	20
21	20	0.3	0.7	1.0	1.4	1.7	2.1	2.4	2.8	3.1	3.4	3.8	4.1	4.5	4.8	5.2	5.5	5.9	6.2	22	21
20	21	0.4	0.7	1.1	1.4	1.8	2.1	2.5	2.8	3.2	3.5	3.9	4.3	4.6	5.0	5.3	5.7	6.0	6.4	21	22
19	22	0.4	0.7	1.1	1.5	1.8	2.2	2.5	2.9	3.3	3.6	4.0	4.4	4.7	5.1	5.5	5.8	6.2	6.6	20	23
18	23	0.4	0.7	1.1	1.5	1.9	2.2	2.6	3.0	3.4	3.7	4.1	4.5	4.9	5.2	5.6	6.0	6.4	6.7	19	24
17	24	0.4	0.8	1.1	1.5	1.9	2.3	2.7	3.1	3.4	3.8	4.2	4.6	5.0	5.4	5.7	6.1	6.5	6.9	18	25
16	25	0.4	0.8	1.2	1.6	2.0	2.3	2.7	3.1	3.5	3.9	4.3	4.7	5.1	5.5	5.9	6.3	6.7	7.1	17	26
15	26	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	16	27
14	27	0.4	0.8	1.2	1.6	2.1	2.5	2.9	3.3	3.7	4.1	4.5	4.9	5.3	5.8	6.2	6.6	7.0	7.4	15	28
13	28	0.4	0.8	1.3	1.7	2.1	2.5	2.9	3.4	3.8	4.2	4.6	5.0	5.5	5.9	6.3	6.7	7.1	7.6	14	29
11	30	0.4	0.9	1.3	1.7	2.2	2.6	3.1	3.5	3.9	4.4	4.8	5.2	5.7	6.1	6.6	7.0	7.4	7.9	12	31
9	1	0.4	0.9	1.4	1.8	2.3	2.7	3.2	3.6	4.1	4.5	5.0	5.4	5.9	6.4	6.8	7.3	7.7	8.2	10	2
7	3	0.5	0.9	1.4	1.9	2.3	2.8	3.3	3.8	4.2	4.7	5.2	5.6	6.1	6.6	7.0	7.5	8.0	8.5	8	4
5	5	0.5	1.0	1.4	1.9	2.4	2.9	3.4	3.9	4.3	4.8	5.3	5.8	6.3	6.8	7.3	7.7	8.2	8.7	6	6
3	7	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	4	8
1	9	0.5	1.0	1.5	2.0	2.5	3.1	3.6	4.1	4.6	5.1	5.6	6.1	6.7	7.2	7.7	8.2	8.7	9.2	2	10
30	11	0.5	1.0	1.6	2.1	2.6	3.1	3.7	4.2	4.7	5.3	5.8	6.3	6.8	7.3	7.9	8.4	8.9	9.5	30	12
28	13	0.5	1.1	1.6	2.1	2.7	3.2	3.8	4.3	4.8	5.4	5.9	6.5	7.0	7.5	8.1	8.6	9.1	9.7	28	14
26	15	0.5	1.1	1.6	2.2	2.7	3.3	3.8	4.4	4.9	5.5	6.0	6.6	7.2	7.7	8.2	8.8	9.3	9.9	26	16
24	17	0.6	1.1	1.7	2.2	2.8	3.4	3.9	4.5	5.0	5.6	6.2	6.7	7.3	7.9	8.4	9.0	9.6	10.1	24	18
21	20	0.6	1.1	1.7	2.3	2.9	3.5	4.0	4.6	5.2	5.8	6.3	6.9	7.5	8.1	8.7	9.2	9.8	10.4	21	21
18	23	0.6	1.2	1.8	2.4	3.0	3.5	4.1	4.7	5.3	5.9	6.5	7.1	7.7	8.3	8.9	9.5	10.0	10.6	18	24
15	26	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	6.6	7.2	7.9	8.5	9.1	9.7	10.3	10.9	15	27
12	1	0.6	1.2	1.8	2.5	3.1	3.7	4.3	4.9	5.5	6.2	6.8	7.4	8.0	8.6	9.2	9.8	10.5	11.1	12	30
9	4	0.6	1.2	1.9	2.5	3.1	3.7	4.4	5.0	5.6	6.3	6.9	7.5	8.1	8.8	9.4	10.0	10.6	11.3	9	2
6	7	0.6	1.3	1.9	2.5	3.2	3.8	4.4	5.1	5.7	6.3	7.0	7.6	8.2	8.9	9.5	10.1	10.8	11.4	6	5
3	10	0.6	1.3	1.9	2.6	3.2	3.8	4.5	5.1	5.8	6.4	7.0	7.7	8.3	9.0	9.6	10.3	10.9	11.5	3	8
30	13	0.6	1.3	1.9	2.6	3.2	3.9	4.5	5.2	5.8	6.5	7.1	7.7	8.4	9.0	9.7	10.3	11.0	11.6	31	11
27	16	0.7	1.3	1.9	2.6	3.2	3.9	4.5	5.2	5.8	6.5	7.1	7.8	8.4	9.1	9.7	10.4	11.0	11.7	28	14
24	19	0.7	1.3	2.0	2.6	3.2	3.9	4.5	5.2	5.9	6.5	7.2	7.8	8.5	9.1	9.8	10.4	11.1	11.7	25	17
21	22	0.7	1.3	2.0	2.6	3.3	3.9	4.6	5.2	5.9	6.5	7.2	7.8	8.5	9.1	9.8	10.4	11.1	11.7	22	20
Add aft. N.	Sub aft. N.	$0^{h}\frac{2}{3}$	$1^{h}\frac{1}{3}$	$2^{h}0$	$2^{h}\frac{2}{3}$	$3^{h}\frac{1}{3}$	$4^{h}0$	$4^{h}\frac{2}{3}$	$5^{h}\frac{1}{3}$	$6^{h}0$	$6^{h}\frac{2}{3}$	$7^{h}\frac{1}{3}$	$8^{h}0$	$8^{h}\frac{2}{3}$	$9^{h}\frac{1}{3}$	$10^{h}0$	$10^{h}\frac{2}{3}$	$11^{h}\frac{1}{3}$	$12^{h}0$	Add aft. N.	Sub. aft. N.
Sub. bef. N.	Add bef. N.	Time from Noon.																		Sub. bef. N.	Add bef. N.

TABLE X. *Change of Sun's Declin.*

Mont.	Days.	Complete Years. 4	8	12	16
January.	1	0′—1	0′—3	0′—4	0′—6
	7	0 .2	0 .4	0 .7	0 .9
	13	0 .3	0 .6	0 .9	1 .2
	19	0 .4	0 .7	1 .1	1 .4
	25	0 .4	0 .8	1 .3	1 .7
February.	1	0 .5	1 .0	1 .5	2 .0
	7	0 .5	1 .1	1 .6	2 .2
	13	0 .6	1 .2	1 .7	2 .3
	19	0 .6	1 .2	1 .9	2 .5
	25	0 .7	1 .3	2 .0	2 .6
March.	1	0 .7	1 .3	2 .0	2 .7
	7	0 .7	1 .4	2 .1	2 .7
	13	0 .7	1 .4	2 .1	2 .8
	19	0 .7	1 .4	2 .1	2 .8
	25	0 +7	1 +4	2 +1	2 +8
April.	1	0 .7	1 .4	2 .1	2 .8
	7	0 .7	1 .4	2 .1	2 .7
	13	0 .7	1 .3	2 .0	2 .6
	19	0 .6	1 .3	1 .9	2 .5
	25	0 .6	1 .2	1 .8	2 .4
May.	1	0 .6	1 .1	1 .7	2 .3
	7	0 .5	1 .0	1 .6	2 .1
	13	0 .5	0 .9	1 .4	1 .9
	19	0 .4	0 .8	1 .2	1 .6
	25	0 .3	0 .7	1 .0	1 .3
June.	1	0 .3	0 .5	0 .8	1 .0
	7	0 .2	0 .4	0 .5	0 .7
	13	0 .1	0 .2	0 .3	0 .4
	19	0 .0	0 .0	0 .1	0 .1
	25	0— 1	0— 1	0— 2	0— 3
July.	1	0 .1	0 .3	0 .4	0 .6
	7	0 .2	0 .4	0 .7	0 .9
	13	0 .3	0 .6	0 .9	1 .2
	19	0 .4	0 .7	1 .1	1 .4
	25	0 .4	0 .9	1 .3	1 .7
August.	1	0 .5	1 .0	1 .5	2 .0
	7	0 .5	1 .1	1 .6	2 .2
	13	0 .6	1 .2	1 .8	2 .4
	19	0 .6	1 .3	1 .9	2 .5
	25	0 .7	1 .3	2 .0	2 .6
September.	1	0 .7	1 .4	2 .0	2 .7
	7	0 .7	1 .4	2 .1	2 .8
	13	0 .7	1 .4	2 .1	2 .8
	19	0 .7	1 .4	2 .1	2 .9
	25	0 +7	1 +4	2 +1	2 +8
October.	1	0 .7	1 .4	2 .1	2 .8
	7	0 .7	1 .4	2 .0	2 .7
	13	0 .7	1 .3	2 .0	2 .6
	19	0 .6	1 .3	1 .9	2 .5
	25	0 .6	1 .2	1 .8	2 .4
November.	1	0 .5	1 .1	1 .6	2 .2
	7	0 .5	1 .0	1 .5	2 .0
	13	0 .4	0 .9	1 .3	1 .8
	19	0 .4	0 .8	1 .2	1 .5
	25	0 .3	0 .7	1 .0	1 .3
December.	1	0 .2	0 .5	0 .7	1 .0
	7	0 .2	0 .4	0 .5	0 .7
	13	0 .1	0 .2	0 .3	0 .4
	19	0 .0	0 .0	0 .1	0 .1
	25	0— 1	0— 1	0— 1	0— 2

TABLE XI. *The Right Aſcenſions and Declinations of the principal fixed Stars, adapted to the beginning of the Year* 1793.

Name of Stars.	Mag.	Right Aſcen. in Time.	Ann. Var.	Declination.	Ann. Var.
γ Pegaſi -	2	0h 2′ 35″	3″.06	14° 1′ 55″ N	+20″.0
β Ceti -	2	0 33 11	3 .01	19 7 32 S	—19 .8
Alrucabah, pole ſtar	2.3	0 50 44	12 .42	88 12 8 N	+19 .6
Mirach -	2	0 58 10	3 .31	34 31 13 N	+19 .4
Achernar -	1	1 30 0	2 .25	58 17 33 S	—18 .5
Almaach -	2	1 51 15	3 .62	41 19 47 N	+17 .7
Menkar -	2	2 51 28	3 .11	3 16 17 N	+14 .7
Algol -	Var.	2 54 45	3 .85	40 8 47 N	+14 .5
Algenib -	2	3 9 38	4 .21	49 6 40 N	+13 .6
Aldebaran -	1	4 24 3	3 .42	16 4 48 N	+ 8 .2
Capella -	1	5 1 25	4 .41	45 46 15 N	+ 5 .1
Rigel -	1	5 4 31	2 .87	8 27 9 S	— 4 .8
β Tauri -	2	5 13 13	3 .78	28 25 1 N	+ 4 .1
Bellatrix -	2	5 14 3	3 .21	6 8 53 N	+ 4 .0
δ Orionis -	2	5 21 27	3 .07	0 27 50 S	— 3 .4
ε Orionis -	2	5 25 44	3 .04	1 20 48 S	— 3 .0
ζ Orionis -	2	5 30 20	3 .03	2 3 52 S	— 2 .6
α Columbæ -	2	5 32 10	2 .17	34 11 34 S	— 2 .4
Betelgueſe -	1	5 43 58	3 .24	7 21 17 N	+ 1 .4
β Canis Majoris	2.3	6 13 37	2 .65	17 51 56 S	+ 1 .2
Canopus -	1	6 19 22	1 .33	52 35 16 S	+ 1 .7
Sirius -	1	6 36 1	2 .65	16 26 35 S	+ 4 .3
δ Canis Majoris	2	6 59 59	2 .44	26 4 32 S	+ 5 .2
Caſtor -	1.2	7 21 22	3 .85	32 19 30 N	— 6 .9
Procyon -	1.2	7 28 27	3 .14	5 45 3 N	— 7 .5
Pollux -	2.3	7 32 37	3 .69	28 30 42 N	— 7 .9
ζ Navis -	2	7 56 19	2 .11	39 25 36 S	+ 9 .7
γ Navis -	2	8 3 10	1 .85	46 43 54 S	+10 .3
Acubens -	3	8 47 8	3 .30	12 39 6 N	—13 .4
β Navis -	1	9 10 54	0 .75	68 52 2 S	+14 .8
Alphard -	2	9 17 24	2 .93	7 46 7 S	+15 .2
Regulus -	1	9 57 20	3 .20	12 58 21 N	—17 .2
η Navis -	2	10 37 4	2 .30	58 36 3 S	+18 .7
β Urſæ Majoris	2	10 49 14	3 .71	57 29 17 N	—19 .1
Dubhe -	2	10 50 49	3 .85	62 52 9 N	—19 .1
β Leonis -	2	11 38 29	3 .06	15 43 47 N	—19 .9
γ Urſæ Majoris	2	11 46 51	3 .22	54 50 47 N	—20 .0
α Crucis -	1	12 15 14	3 .24	61 57 6 S	+20 .0
γ Crucis -	2	12 19 47	3 .24	55 57 2 S	+20 .0
β Crucis -	2	12 35 46	3 .41	58 33 19 S	+19 .8
Aliath -	2	12 44 51	2 .67	57 5 14 N	—19 .7
Spica Virginis -	1	13 14 18	3 .13	10 4 31 S	+19 .0
ζ Urſæ Majoris -	2	13 15 32	2 .43	56 0 41 N	—19 .0
Benetnach -	2	13 39 23	2 .40	50 21 7 N	—18 .2
β Centauri -	1.2	13 49 23	4 .11	59 21 49 S	+17 .8
Arcturus -	1	14 6 13	2 .72	20 15 58 N	—19 .1
α Centauri -	1	14 26 1	4 .45	59 58 44 S	+16 .1
Alphacca -	2	15 25 55	2 .53	27 25 16 N	—12 .5
β Scorpii -	2	15 53 26	3 .47	10 13 29 S	+10 .5
Antares -	1	16 16 44	3 .64	25 57 22 S	+ 8 .7
Ras. Algethi -	2	17 5 13	2 .73	14 38 18 N	— 4 .8
Ras. Alhague	2	17 25 20	2 .77	12 43 28 N	— 3 .0
Vega -	1	18 29 56	2 .02	38 35 51 N	+ 2 .6
Altair -	1.2	19 40 41	2 .92	8 19 48 N	+ 8 .5
Deneb -	2	20 34 22	2 .03	44 32 51 N	+12 .5
Gruis -	2	21 55 6	3 .85	47 57 8 S	—17 .1
Fomalhaut -	1	22 46 10	3 .33	30 42 51 S	—19 .0
Scheat -	2	22 53 45	2 .87	26 57 41 N	+19 .2
Markab -	2	22 54 27	2 .96	14 5 42 N	+19 .2
Andromedæ -	2	23 57 43	3 .07	27 56 51 N	+20 .0

Inland Navigation.

Navigation of the ancients. See Phœnicia and Trade.

Inland Navigation, the method of conveying commodities from one part of a country to another by means of rivers, lakes, canals, or arms of the sea, penetrating far into the internal parts. See the article Canal.

The advantages of this mode of conveyance, in an extensive and populous country, are sufficiently obvious; whether we take into account the superior cheapness, facility, or quickness with which great quantities of goods can thus be carried from one place to another, or the advantages which may accrue to agriculture and other arts, by thus conveying manures, the produce of the ground, or heavy manufactured goods, to and from distant quarters; which would be altogether impracticable by a land-carriage, without incurring a much greater expence than the commodities could bear. The good effects of inland navigation are particularly evident in the vast empire of China, and in the states of Holland. In both these countries, the multitude of canals undoubtedly contributes to the opulence of the inhabitants, both by the more free scope they give to trade, and the advantages derived from them to agriculture; not to mention, that by means of the canals themselves the ground is often meliorated and made capable of producing both corn and pasture, where otherwise it would perhaps yield neither, or at least very imperfectly. These countries, however, particularly Holland, are very flat, and thus very much fitted for this kind of navigation: Great Britain and Ireland are less so, on account of the greater inequality of their surface; though in them also the making of canals is now become very common, notwithstanding the immense expence with which such undertakings are attended.

In a late treatise upon this subject by Mr Edmund Leach surveyor, the author considers the advantages which might accrue to the kingdoms of Britain and Ireland, were their inland navigation improved as much as it might be; and he considers both countries as exceedingly proper for improvements of this kind on account of the number of fine streams of water they contain. "Every county (says he) in each kingdom is furnished with rivers and streams of water; very few, if any, of which but may be made navigable to within a mile or two of their sources" by the method he proposes.

The method of making canals hitherto practised, is so fully described under the article Canal, that nothing needs be said upon it in this place. Mr Leach observes, that all the artificial inland navigations made in this, as well as in other kingdoms, have been done by beginning them at the foot or mouth of a river, or at the utmost extent of the ebb or flow of the tide; proceeding thence upwards, either in the ordinary course of the river by sinking, widening, and cleansing it; then with the assistance of a lock and dam to raise the boats or other vessels to a higher level. This is next to be cut, widened, and cleansed as before, till we come to a third level, when the vessels are to be raised as in the former; proceeding thus, as it were step by step, till we arrive at the extent of the intended navigation. Otherwise the navigation is carried on by an artificial side-cut or canal near the course of the river, raised up by locks and dams as before. These methods, however, tho' probably of very great service to the country, are attended with many and considerable inconveniences. Inland Navigation.

1. Every river or other stream is the natural receptacle of all the springs, rains, and floods, which discharge themselves into it; by which means it sometimes discharges such torrents of water as sweep every thing away before them. This not only interrupts the navigation for a time, but is often attended with the most intolerable expence.

2. The original making of the canal with a number of locks and dams, such as is described under the article Canal, must also be very expensive.

3. Some rivers run very rapidly in particular places; and if the descent of the bed be very great, it will require a number of the locks and dams already mentioned to make such a river navigable, though the navigation should extend but a few miles from the mouth.

4. The passing of the locks is always attended with a considerable difficulty, besides the loss of time and expence.

To obviate all these inconveniences, Mr Leach proposes to begin and carry on his canal in a manner precisely the reverse of that just now described. In his method, the canal is to be begun as near the source of the river as possible; that is, as near as there is a probability of having water in the driest seasons sufficient to fill the canal; of which there can be but little required, as a stream sufficient to turn an ordinary mill must be sufficient to answer all the purposes of such a canal. Thus the navigation may be carried up much higher than in the ordinary canals with dams and locks. If a canal be made properly, and the sides and bottom plastered with a cement that may be made of the same earth and clay saved in making the trunk, very little water will be requisite to keep it full. Our author supposes that a stream sufficient to turn an ordinary mill will be sufficient to keep it full, even if the canal should be 20 miles long.

To construct a canal of this kind, we must make choice of a level as near the head of the river as possible; this level must be continued for a considerable way, so that the water may not have the least current, but may absolutely stagnate. Thus the original bed of the river will soon be left at a distance, and the stagnant canal will become higher and higher with respect to it, in proportion to the descent of the ground or rapidity of the river. Having proceeded this way as far as convenient, the vessels must be let down by a machine (to be afterwards described) into the bed of the original river, or from one elevated canal to another much lower; perhaps 10, 15, or 20 fathoms.

By this perfect stagnation of the water in the canals, there will be no danger of washing off the plastering from the sides and bottom, so that the only waste of water will be by evaporation, and what is required for working the machine above mentioned; which, as it is only required at particular times when vessels are to be raised or lowered, must be very trifling, and cannot bear any proportion to the constant supply at the head of the canal.

In order to keep the first level easily, and for a considerable way, it will be necessary to avoid the many valleys which are naturally to be met with near the original river, by the descent of other streams into it.

Inland Navigation.

Hence canals conſtructed on the plan recommended by our author muſt run out in ſerpentine windings a conſiderable way into the country, which will augment its length greatly beyond that of the original river; and thus a much greater number of people, and larger extent of country, will reap the benefit of it than if it was continued in a ſtraight line. "One inconvenience (ſays our author) attending the old inland navigations that are carried on in or nigh the original rivers, is their being confined within too ſmall a ſpace of land, and where, for the moſt part, there is the leaſt occaſion either for water to water the land, or for manure to enrich the ſoil; whereas, by beginning a canal near the head of a river, and by continuing it on one common level, if the river have any thing of a deſcent, and runs pretty rapid, the original river and its valley is ſoon left, and the canal is removed up into the ſide of the hill, where there is generally moſt occaſion for manure and water both; and the further on it is continued, and the more rapid the river runs, the further the navigation is removed from the valley and the original courſe of the river, till it is brought to the place deſigned for the purpoſe of transferring the veſſels down at once by a machine into the original river, the ſea, or into another canal."

Notwithſtanding the advantages which attend this new mode of conſtruction, our author acknowledges that there are ſome caſes in which the old method only can be put in practice.

With regard to the ſize, form, and expence of canals of this kind, Mr Leach gives a computation from one which was intended to be made in the county of Cornwall, and which was called the *Tamar* canal. An act of parliament was obtained for this in 1774. A navigable canal was to be made from Bude Haven, in the county of Cornwall, on the Briſtol Channel, to the navigable part of the river Tamar; the deſign being to open a communication between the Engliſh and Briſtol Channels through the counties of Devon and Cornwall. By the act, it was determined that the canal ſhould not exceed 63 feet in breadth, nor ſhould the ground be cut more than 39 inches deep below the ſurface, excepting in places where docks or baſons were to be made, or where cranes or other engines were to be erected for particular purpoſes. The breadth allowed (63 feet) was to comprehend the water itſelf, the two towing paths, one on each ſide, and the fences beyond them. The breadth of the canal itſelf was to be 21 feet at the ſurface and 12 at bottom; the depth on the under ſide, 39 inches, as already ſaid; the towing paths 12 feet broad each; and beyond theſe an hedge or rail at the diſtance of ſix feet on each ſide from the paths. There were to be drains as uſual in canals; one on the under ſide for carrying off the ſuperfluous water from the canal; the other on the upper ſide for carrying off the water which might accidentally fall into it in rains, or by ſprings in the higher grounds. Thus the whole would not exceed the breadth propoſed by act of parliament; while the canal itſelf would be ſufficiently large for every neceſſary purpoſe. Mr Leach computes, that on this canal two boats, carrying 10 tons each, might very eaſily paſs: and he recommends this as the proper ſize of canals in other parts of the kingdom

Canals of this kind, our author obſerves, will, for the moſt part, be made in the ſide of an hill or riſing ground; whence the greateſt part of the earth dug out of it will be thrown upon the under ſide. Here it will elevate the ground ſufficiently to form a towing path, together with an elevated ſpace whereon to plant the hedge or fence. On the higher ſide, 12 feet of the ground muſt be cut down to within 18 inches of the ſurface of the water; and the earth and ſtones dug out in making this path will make the fence on the outſide for keeping off the cattle. As by the act of parliament, however, there is a greater breadth allowed in ſome places, for making docks or baſons, our author calculates the whole breadth of the canal at 66 feet; and according to this breadth he makes his computations.

1. The firſt and principal expence is the digging of the trunk of the canal; but this muſt vary ſo much according to the nature of the ground, that no certain eſtimate of the expence can be made. Sometimes the ground may be ſoft, and eaſily cut, ſometimes hard and rocky, ſometimes marſhy and boggy, &c. There muſt alſo be a very conſiderable difference in the expence of cutting the canal, according as the ground on one ſide of it is more or leſs elevated. Mr Leach, after making the proper calculations, ſuppoſes that in every perch of a canal of the kind under conſideration there muſt be removed 40$\frac{1}{7}$ cubical yards, or 1085 cubical feet, of earth. Agreements with the workmen are commonly made by the cubic yard. It is rare that a cubic yard can be removed for leſs than 2d. "nor (ſays our author) will any ſort of ground require more than 9d. except in paſſing through a rock, which will not often happen, unleſs where, by the ſituation of the land through which the canal may paſs, it ſhould require to be cut more than four feet under the ſurface, as it may ſometimes happen in cutting through a hill or neck of land, whereby the courſe of the canal may be ſhortened. According to this eſtimate, Mr Leach has formed a table of the expence of making canals from 2d. the cubic yard to 9d. The ſmalleſt expence of theſe per mile is L. 107 : 11 : 1$\frac{1}{2}$; the greateſt L. 483 : 19 : 9. Sometimes, however, the expence may be even greater; ſo that the mile may coſt L. 600, or near it; but this muſt be accounted an extraordinary expence, and not often to be expected.

In digging the trunk of the canal, care muſt be taken to preſerve all the ſand, ſtones, and gravel, for the purpoſe of making drains or gutters and the towing paths; alſo for the making of a wall, the outſide face of which is to be 21 feet diſtant from the edge of the canal. The deſign of this is to prevent the earth and rubbiſh from being thrown to too great a diſtance from the ſide of the canal; and likewiſe for the purpoſe of raiſing a bank on the lower ſide about 16 or 18 inches above the ſurface of the water in the canal, when it is full up to the drains. On the top of this bank the towing path is to be made 12 feet wide on that ſide of the canal; and if this wall ſhould be raiſed four feet above the ſurface of the towing path, it would be a fence to keep the cattle off from that ſide. In making the towing path on the higher ſide, the ſurface of the land muſt be ſunk to within 16 or 18 inches of the ſurface of the water in the canal when full; and the turf, earth, ſtones,

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ſtones, &c. taken from thence in making the towing path on that ſide, will make the other fence of the canal.

2. Drains or gutters muſt be made under the towing paths, on both ſides of the canal. On the upper ſide they muſt be made through the hedge or fence at all convenient places, for admitting ſprings and rivulets, as well as rain-water into the canal. On the higher ſide, theſe ſhould be about 132 feet diſtant from one another, excluſive of thoſe for the admiſſion of ſprings. On the lower ſide, it is neceſſary to have drains at the diſtance of 66 feet from each other; which will be 80 drains per mile. Theſe may be conſtructed for 2s. 6d. each, which amounts to L. 10 per mile. On the higher ſide they will coſt about four ſhillings per drain; and, at the diſtance of 132 feet betwixt each drain, the expence will be L. 8 per mile.

In making the drains on the lower ſide, great care muſt be taken to have them truly level, and parallel to the horizon; the bottom part of the drain being exactly 39 inches perpendicular above the bottom of the canal; as on the true placing of theſe drains, and the true level of the bottom of the canal, entirely depends the regularity of the deepneſs of the water.

3. The value of the ground through which the canal is to paſs muſt alſo be conſidered. From the obſervations and memorandums which our author took in the year 1774, concerning the ground through which the Tamar canal was to paſs, he concluded that one eighth part of the land through which the tract paſſed was worth 40s. per acre; another eighth, 20s.; a third eighth part, 10s.; and all the reſt not worth more than five; and a great deal of it not more than two; the average of the whole being 15s. an acre. "Then (ſays he), if the good, indifferent, and bad land be worth, on an average, 15s. an acre, and as 30 years value is a capital price for lands, it will, at that rate, amount to 22l. 10s. per acre. The ſtipulated breadth of the canal with the towing paths and hedges being, as already ſaid, 66 feet, which is exactly a gunter's chain; then, 10 ſuch chains in length and one in breadth form exactly a ſtatute acre of land; and ten chains in length is a furlong; ſo that every mile of canal will thus take up eight acres of land, which, at 22l. 10s. per acre, amounts to 180l. per mile.

4. Bridges are likewiſe a conſiderable article of expence in the making of canals. Mr Leach ſuppoſes that there may be one common road bridge and two ſwivel bridges required per mile; the former may be erected for 60l. and the latter for 30l. each; ſo that the expence of all together will amount to 120l. per mile.

5. As in ſome particular places, on account of ſhort turns, and where docks and baſons and landing places are to be made, a greater wideneſs will be required, our author allows half an acre more land for every furlong on this account; which brings an additional expence of 90l. per mile.

6. It will always be neceſſary to have ſluices for emptying the canal; each of which will coſt 20l. Mr Leach allows a ſluice and ſtop-gate for every mile; and as theſe coſt 20l. each, we have thus a farther expence of 40l. per mile.

7. The wall on the lower ſide againſt the bank of earth and towing path may be built for three ſhillings per perch; and as every mile contains 320 perches, the expence of the wall will be 48l. per mile.

8. Our author calculates the towing path on the lower ſide at the ſame price; ſo that it alſo makes an addition of 48l. per mile; but as he eſtimates the higher towing path and hedge at 8s. per mile, this will amount to 128l. per mile.

Thus, according to our author's calculation, the whole expence of making a canal with its neceſſary appendages will amount to L. 944 : 13 : 4½ per mile; and by the calculation of another engineer, the particulars of which he alſo enumerates, it would not exceed L. 1032 : 13 : 4½. This our author thinks a moderate expence; but an objection naturally occurs from the great length to which ſuch canals muſt neceſſarily run; a remarkable inſtance of which he gives in the propoſed Tamar canal; where, though the diſtance betwixt Bude Haven and the navigable part of the river Tamar is no more than 28 miles in a ſtraight line, the length of the canal would not have been leſs than 80 miles. This length, however, according to our author, "ought not to be an object of diſcouragement, but on the contrary an inducement and an encouragement to promote the extending of it as much as poſſible into the country, as it will bring a market to every man's door that it draws nigh in its paſſage, and be a means to improve a greater quantity of uncultivated lands; and the navigation will be thereby much more extenſive, and a much larger number of inhabitants will reap the advantages thereof, than if it had been carried on upon the original river."

We have already taken notice, that in the method of conſtructing canals juſt now mentioned, there will at certain intervals be places where the veſſels muſt be raiſed and lowered by means of mechanical powers, inſtead of the dams and locks made uſe of in other canals. Theſe machines are compounded of an inclined plane and wheel in axis. The inclined plane is a parallelogram whoſe length reaches from the end of one canal to the beginning of another, or to the ſea or navigable river, to which the veſſel is next to be conveyed; the breadth ought to be 22½ feet. It may be made of good oak or deal plank, and ſufficiently ſtrong to bear the weight to be laid upon it; and it muſt be very ſtrongly ſupported by beams of oak or other wood. It ought to be divided in the middle by a ledge or rib of 12 inches ſquare, the ſide ribs being nine by 12 inches. The elevation muſt depend upon particular circumſtances. Fig. 1. ſhows the inclined part of the machine; AB being the wooden part juſt deſcribed, placed between the ſide of the hill W and the navigable river F. According to the dimenſions already given, the two paths A and B on which the veſſels move are exactly ten feet wide. G repreſents the canal, brought perhaps from the diſtance of ſeveral miles to the top of the precipice WW. At the end of the canal, and quite acroſs from R to R, muſt be built a very ſtrong wall; in which are two ſluices with flood-gates at K and L, to let out the water occaſionally. Between the head of the plane AB, and the end of the canal G, is a horizontal platform divided into two parts, as is repreſented in the figure by the letters HI. At the end of the canal are ſix

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rollers M and N, of uſe in carrying the boats and lighters in and out of the canal. Near the end of the canal, at S and T, are two other ſluices, with their flood-gates, for letting out a quantity of fluid to drive the other part of the machine. O and P repreſent the two ends of the towing paths, one on each ſide of the canal.

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Fig. 2. ſhows the vehicle by which the lighters are conveyed up and down the inclined plane, by the two paths A and B, fig. 1. AA (fig. 2.) repreſents part of the inclined plane, B the vehicle in the poſition in which it rolls up and down the two paths. C is the body of the vehicle, which is made hollow, to contain a quantity of water occaſionally uſed as a counterbalance for its correſponding vehicle. DDD are three rollers between the bottom of the vehicle and the plane, for the purpoſe of rolling the boats up and down. HHH are ſix rollers; four on the horizontal part of the vehicle on which the boat E is to reſt in its paſſage up and down the plane; the other two rollers are in a moveable part, which is faſtened to the body of the vehicle with a pair of very ſtrong hinges; and in the paſſage of the vehicle up and down the plane it turns up between the head of the boat and the plane, preventing the former from rubbing againſt the plane. When the vehicle gets up to the top, this moveable part falls down on the platform marked HI, becoming parallel with the horizontal part of the vehicle; after which it ſerves as a launch and paſſage to place the boat upon the rollers MN (fig. 1.) at the end of the canal. This paſſage part of the vehicle, together with the three rollers at the end of the canal, is likewiſe of great uſe in towing a boat out of the canal, in order to place it on the horizontal part. At the bottom of the cavity of the vehicle is a large hole F, with a valve opening inwardly. Through this hole the water enters when the vehicle ſinks into the navigable river F, for the purpoſe of receiving a boat on the top or horizontal part of the vehicle, till it is quite full; and will then ſink entirely under water, while the boat is towed in on the horizontal part. A ſmall rope K is faſtened to the valve, on purpoſe to lift it up, and to keep it ſo while the vehicle and boat are aſcending up the plane out of the canal, that ſo the water may diſcharge itſelf till as much as is neceſſary be got out; or till it becomes an equal balance for the correſponding vehicle and its contents, which are deſcending by the other path. Hence we ſee, that every machine muſt have two of theſe vehicles furniſhed with rollers as already deſcribed, and ſo conſtructed that one may be as nearly as poſſible a counterbalance to the other. As it is neceſſary that the vehicles ſhould be water tight, the inſides of them muſt be caulked very tight; and they ſhould be capacious enough to hold as much water as will balance the largeſt boat with its contents. Here it may be obſerved, that every veſſel will be balanced by as many cubic feet of water as it diſplaces by being put into the water when loaded. The quantity may eaſily be known, by obſerving how far the boat ſinks in the water, and calculating the bulk of the part immerſed.

The machine which puts the vehicles in motion, may either be conſtructed with an under-ſhot or breaſt-water-wheel; by an over-ſhot water-wheel; or by two walking-wheels, for men to walk in as in cranes, &c.

Fig. 3. ſhows a front view of the under-ſhot water-wheel movement; where A is the end of the axis or cylinder of the cog or ſpur-wheel; the diameter of which axis is four feet, and its length not leſs than 22 feet, as it muſt be extended quite acroſs the canal from one ſide to the other, and placed on the top of very ſtrong ſupporters on each ſide of the canal, about ſeven feet above the ſurface of the water, as the loaded boat is to paſs backwards and forwards under the cylinder, and at a convenient diſtance from the wall RR (fig. 1.) and placed between the two ſluices S and T; on the end of which cylinder is the cog-wheel B (fig. 3.) The wheel B is ſuppoſed to be 20 feet in diameter, having on its edge 120 cogs; and underneath the cog-wheel is the breaſt-water one C, 24 feet in diameter from the tip of one aller-board to the tip of its oppoſite. On the end of the axis of the water-wheel D is a trundle two feet and an half in diameter, with 15 rounds or ſtaves contained therein. This muſt be placed between the two ſluices S and T, to let the water out of the canal; which, falling on the float-boards, will turn the wheel round from the right hand towards the left, when the ſluice on the left hand of the wheel is opened; but the contrary way when that on the right is opened.—The water falling upon the boards paſſes along with the wheel in the circular cavity EGF, and is diſcharged at G, whatever way the wheel may turn.

To the axis or cylinder of this machine, which muſt always be horizontal, are fixed two pair of ſtrong ropes; the ends of each pair faſtened to the upper part of the cylinder; it being neceſſary that they ſhould act in contrary directions. Each muſt extend the whole length of the plane, and their ſtrength muſt be proportioned to the weight neceſſary to be ſuſtained. The two vehicles already mentioned are faſtened to the other ends of the ropes; ſo that one pair of the ropes are wound up by the cylinder turning one way, and the other by its turning the contrary way. Thus, when one of the vehicles is at the upper part of the path A, ready to diſcharge its boat and cargo into the upper canal, the other boat will be at the foot of the path B, all under water in the lower canal, and ready for the reception of a boat to be towed in on the horizontal part of it; ſo that as one vehicle rolls up on one ſide of the plane, the other will roll down on the other ſide, and *vice verſa*. Fig. 1

Fig. 4. ſhows the movement by means of an over-ſhot water-wheel. It conſiſts of a water-wheel C, and two ſpur or cog-wheels A and B. The water-wheel is 18 feet in diameter, and has two rows of buckets placed contrariwiſe to one another, that it may turn round in contrary directions, according as the one or the other ſluice, S or T, is opened. On its axis F is a trundle of three feet diameter, having 18 rounds or ſtaves which fall into the cogs of the ſecond ſpur-wheel B, cauſing it to turn round in a direction contrary to that of the water-wheel. This ſecond wheel is likewiſe 18 feet in diameter, with a trundle of three feet, having 18 rounds or ſtaves.—The diameter of the upper ſpur-wheel A is alſo 18 feet, but the diameter of its axis is ſix feet. On the edge of the wheel are 108 cogs. Theſe fall in between the ſtaves of the axis of the other ſpur-wheel; and thus the third wheel turns round the ſame way with the water-wheel C. The cylinder of this upper ſpur-wheel

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wheel muſt be placed acroſs the canal betwixt the two ſluices, on very ſtrong ſupporters, as explained in the former movement, and the two pair of ropes in the ſame manner.

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The movement of the walking-wheel is ſhown (fig. 5.) A1 and A2 are two wheels for men to walk in, each of them 24 feet in diameter. B1 and B2 are the axes or cylinders of the two wheels, of equal lengths; viz. 11 feet each, and four in diameter. — At one end of each of the two cylinders C1 and C2, is a wheel of the ſame diameter with the cylinder. On the edges of theſe wheels are teeth of an equal number in each wheel; and as the teeth of the wheels mutually fall into each other, the revolutions of both muſt be performed in the ſame time. By this contrivance alſo the cylinders will turn different ways; and the ropes on the two different cylinders will conſtantly one pair be wound up, and the other wound down, by the natural moving of the machine. DDD is the frame that ſupports the whole, which muſt be made very firm and ſecure.

Let us now ſuppoſe, that there is a boat in the upper canal to be brought down, but none to go up for a balance. In this caſe, as one of the vehicles muſt be at the top to receive the boat, the other will be at the bottom to take in water. Let then any of the movements juſt deſcribed be ſet to work, and it is plain, that as the upper vehicle with its boat deſcends, the under vehicle will aſcend with the water; the valve being in the mean time lifted up till a ſufficient quantity of water has flowed out, to make the one nearly a counterbalance to the other; ſo that the veſſel may ſlide down gently and without any violence.

If it happens that a boat is to go up while none is to come down, one of the vehicles being at the foot of the plane under water, and in readineſs to have the boat towed upon its horizontal part, one of the ſluices at K or L is to be opened, and a quantity of water let into the ciſtern of the upper vehicle ſufficient to counterbalance the boat with its contents which is to aſcend. This being done, the machine is ſet to work, the valve of the under vehicle kept open till the water is all diſcharged; and then the boat will roll up to the top of the plane.

From this deſcription of the canal and machinery for raiſing and lowering the veſſels, the reader can be at no loſs to underſtand the principles on which it depends. It would be ſuperfluous to adduce examples, or follow our author through his calculations relative to particular caſes. We ſhall only obſerve, that the difference of time in which veſſels may be raiſed or lowered by the machinery juſt deſcribed, in compariſon with what can be done in the common way by dams and locks, muſt give a very favourable idea of the new method. According to Mr Leach's computations, a boat with its cargo weighing 10 ton might be raiſed by the walking-machine in 12 or 14 minutes, by the underſhot-wheel in 15 minutes, and by the overſhot-wheel in 30 minutes; and that through a ſpace of no leſs than 30 fathoms meaſured on the inclined plane, or 114 feet perpendicular.

NAULUM, a piece of money put into the mouth of a perſon deceaſed among the Romans, to enable him to pay Charon the ferryman for his paſſage. It was to be of the current coin of the reigning emperor: from this money then the time of the perſon's death may be known. The ſum for poor men was a farthing, but the rich in general were very liberal to the old tar Charon, as appears from the number of coins often found in the neighbourhood of Rome on opening the graves of great men. Charon was looked upon as a very moroſe and obſtinate old fellow, who would not carry over any man without his fare: and hence the proverbial uſe of that verſe in Juvenal,

Furor eſt poſt omnia perdere naulum.

A ſimilar cuſtom took place among the Greeks; but the money put into the mouth of the deceaſed was called Δαναχη.

Naumachia || Naupactus.

NAUMACHIA, in antiquity, a ſhow or ſpectacle among the ancient Romans, repreſenting a ſea-fight. Theſe mock ſea-fights are ſuppoſed to have originated at the time of the firſt Punic war, when the Romans firſt inſtructed their men in the knowledge of naval affairs. Afterwards they were intended to entertain the populace, as well as to improve the ſeamen. They were often like other ſhows exhibited at the expence of individuals, to increaſe their popularity.

In theſe ſpectacles they ſometimes ſtrove to excel each other in ſwiftneſs; and ſometimes engaged in a warlike manner. The Naumachiæ of Claudius indeed was a moſt ſavage diverſion. The combatants uſed to deſtroy each other to amuſe a tyrant and a cruel mob. As they paſſed before him, they uſed this melancholy greeting, "*Ave Imperator, morituri te ſalutant.*" The emperor replied, "*Avete vos.*" This they underſtood as an anſwer of kindneſs, and a grant of their lives; but they ſoon diſcovered that it proceeded from wanton cruelty, and barbarous inſenſibility. In the time of the emperor Domitian, ſuch a vaſt number of veſſels engaged as would have nearly formed two regular fleets for a real fight, and the channel of water was equal in magnitude to a natural river. The emperor Heliogabalus is reported to have filled the channel where the veſſels were to ride with wine inſtead of water. Tritons and ſea-monſters were frequently exhibited during the engagement. Suetonius and Dio Caſſius inform us, that at one of theſe ſea-fights of Domitian a violent ſhower fell; the emperor, however, continued till the end of the engagement, often changing his clothes, nor would he ſuffer any one to depart; and as the rain continued for ſeveral hours, many were ſeized with diſtempers, and ſome even died, Suet. cap. 4. Dio, lib. lxvii. Naumachiæ were alſo places fitted up for theſe ſhows, a ſort of circus's or amphitheatres, with ſeats and porticos, &c.: there were ſeveral of them at Rome; three built by Auguſtus, one by Claudius, another by Domitian, and another by Nero; which ſerved for the reverſe of his medals. Claudius uſed the lake Fucinus as a Naumachia.

NAUMBURG, a town of Germany, in the circle of Upper Saxony, capital of the county of Saxe-Naumburg, ſituated on the river Sala, in E. Long. 11. 20. N. Lat. 51. 12.

NAUPACTUS, or NAUPACTUM, (anc. geog.) a city of Ætolia, at the mouth of the Evenus. The word is derived from ναυς and πηγνυμι, becauſe it was there that the Heraclidæ built the firſt ſhip which carried them to Peloponneſus. It firſt belonged to the Locri Ozolæ, and afterwards fell into the hands of the Athenians, who gave it to the Meſſenians, who

Nauplia || Nauſcopy.

had been driven from Peloponneſus by the Lacedemonians. It became the property of the Lacedemonians after the battle of Ægoſpotamos, and it was reſtored to the Locri. Philip of Macedonia afterwards took it, and gave it to the Ætolians; from which circumſtance it has generally been called one of the chief cities of their country. E. Long. 22. 20. N. Lat. 38. 0.

There was on the ſhore a temple of Neptune, and near it a cave filled with offerings, and dedicated to Venus, where widows reſorted to requeſt new huſbands of the goddeſs. Pauſan. lib. 10. p. 898.

NAUPLIA, (anc. geog.), a maritime city of Peloponneſus. It was the naval ſtation of the Argives. The fountain Canathos was in its neighbourhood.

NAUPLIUS, (fab. hiſt.), a ſon of Neptune and Amymone, king of Eubœa. He was the father of the famous Palamedes, who was ſo unjuſtly ſacrificed to the artifice and reſentment of Ulyſſes by the Greeks at the Trojan war. The death of Palamedes highly enraged Nauplius; and to revenge the injuſtice of the Grecian princes, he endeavoured to debauch their wives, and ruin their characters. When the Greeks returned from the Trojan war, Nauplius was pleaſed to ſee them diſtreſſed in a ſtorm on the coaſts of Eubœa; and to make their diſaſter ſtill more univerſal, he lighted fires on ſuch places as were ſurrounded with the moſt dangerous rocks, that the fleet might be ſhipwrecked upon the coaſt. This had the deſired effect; but Nauplius was ſo diſappointed when he ſaw Ulyſſes and Diomedes eſcape from the general diſtreſs, that he threw himſelf into the ſea. According to ſome mythologiſts there were two perſons of this name, a native of Argos, who went to Colchis with Jaſon. He was ſon of Neptune and Amymone.—The other was king of Eubœa, and lived about the time of the Trojan war. He was, as ſome obſerve, ſon of Clytonas, one of the deſcendants of Nauplius the Argonaut. The Argonaut was remarkable for his knowledge of ſea affairs and of aſtronomy. He built the town of Nauplia, and ſold Auge daughter of Aleus to king Teuthras, to ſcreen her from her father's reſentment.

NAUPORTUS, or NAUPORTUM, (anc. geog.), a town on a cognominal river, towards its ſource, in Pannonia Superior. The reaſon of the name, according to Pliny, is, that the ſhip Argo, after coming up the Danube, the Save, and the Laubach, was thence carried on mens ſhoulders over the Alps into the Adriatic. The river Nauportus riſes in the Alps, near Longaticum, at the diſtance of ſix miles from the town Nauportum; which was a colony of the Tauriſci, a people on the confines of Noricum. Now *Upper Laubach* in Carinthia, on the river Laubach. E. Long. 14. 40. N. Lat. 46. 28.

NAUSCOPY, the art of diſcovering the approach of ſhips or the neighbourhood of land at a conſiderable diſtance. This pretended art was invented by a M. Bottineau, employed in the King and Company's ſervice in the iſland of France, from the year 1782 to 1784; and the account of it is given by the inventor as follows:

"This knowledge is not derived either from the undulation of the waves, or from the ſubtilty of ſight, nor from any particular ſenſation; but merely from obſervation of the *horizon*, which diſcovers ſigns indicating the proximity of ſhips or of land. Nauſcopy.

"On the *approximation* of a ſhip towards the land, or towards another ſhip, there appears in the atmoſphere a *meteor* of a particular nature, viſible to every one without any *painful attention*. It is not by any kind of accident that this meteor appears under theſe circumſtances; on the contrary, it is the neceſſary reſult of the approximation of one veſſel towards another, or towards the land. The exiſtence of the *meteor*, and the knowledge of its different modifications, are what conſtitute the certainty and the preciſion of my informations.

"If I am aſked, how it is poſſible that the approach of a ſhip towards land ſhould give birth to any *meteor* whatſoever in the atmoſphere, and what connection there can be between two objects at ſuch a diſtance from each other? I reply, that I am not obliged to give an account of the *hows* and the *wherefores*; that it is ſufficient for me to have diſcovered the fact, without being obliged to account for its principle."

The writer concludes, by deſiring to be called on for experimental proofs, and by promiſing in future a complete treatiſe of Nauſcopy, with maps, plates, &c.

This complete treatiſe, as far as we know, has not yet been publiſhed, nor do we expect ever to ſee ſuch a treatiſe on the ſubject as will ſatisfy the minds of thoſe who are perſuaded that every effect muſt have an adequate cauſe. The adminiſtrators of the iſland, who gave to M. Bottineau what he calls a *report*, containing the moſt authentic and moſt explicit teſtimony of the reality of the diſcovery, ſeem to be of our opinion; and yet they ſpeak of this diſcovery with doubt, and with a degree of reſpect to which we think it can lay no claim. Their report is in the form of a letter directed to the *Marechal de Caſtries*: and that our infidelity may not deprive the public of what, in the immenſe catalogue of poſſibilities, *may* lead to a uſeful diſcovery, we ſhall here ſubjoin a copy of it.

Port Louis, Iſland of France, the 18th February 1784.

"My Lord, A letter which you have written on the 6th of April to M. Bottineau, employed in the King and Company's ſervice in this colony, obliges us not to refuſe him one for you, of which he propoſes being himſelf the bearer. The deſire only of being uſeful to his country, is (as he ſays) the motive which determines him to take this ſtep. He would be angry with himſelf were he to conceal a diſcovery which hath hitherto eſcaped the moſt enlightened perſons, and of which he only is in poſſeſſion. This diſcovery is the art of announcing the preſence of one or ſeveral ſhips, at 100, 150, and as far as 200 leagues diſtance. This is by no means the reſult of his ſtudies, nor the fortunate application of the principles of any particular ſcience; his ſcience is in his eyes only, and he can have no other: what we call *penetration* and *genius* cannot make up to him what he is deficient in from education. He perceives (as he ſays) in nature, ſome ſigns which indicate to him the preſence of the veſſels, as we know that there is a fire in a place when we perceive the ſmoke which comes from it. This is the compariſon which he makes uſe of himſelf to thoſe who have converſed with him about his art: this (though he has kept his ſecret to himſelf)

Fig. 1.

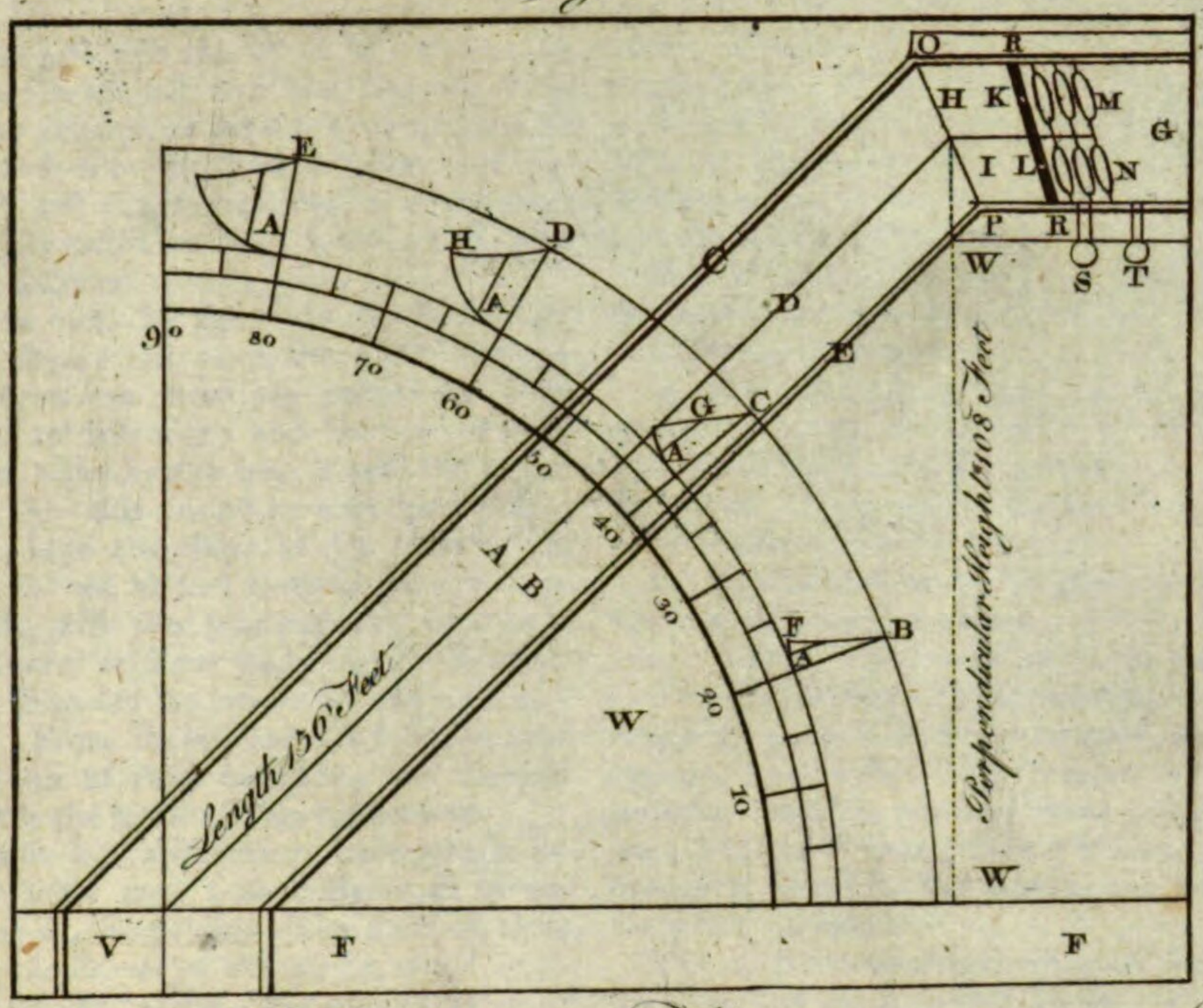


Fig. 2.

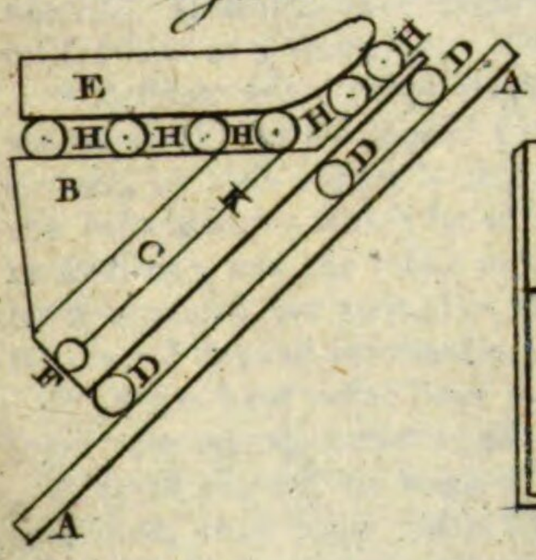
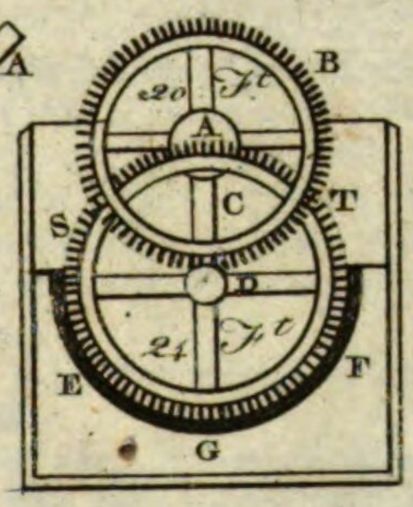


Fig. 3.



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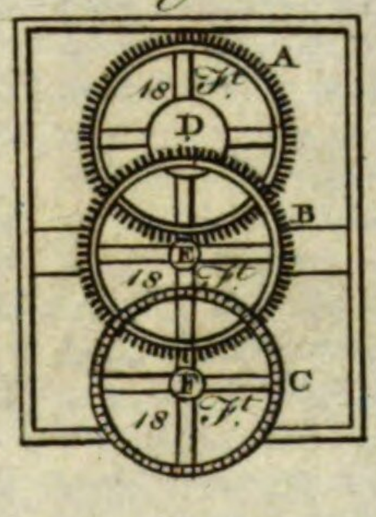

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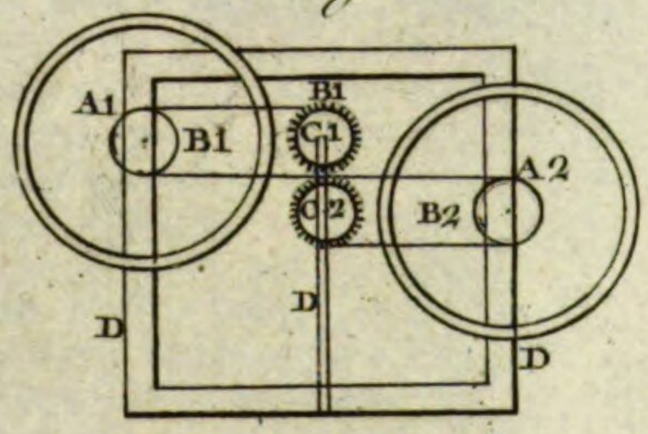


Napiers. Rods.

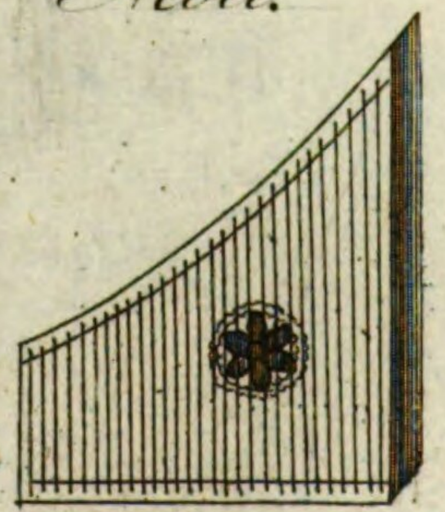
N.o 1.

1	1	2	3	4	5	6	7	8	9	0
2	2	4	6	8	1/0	1/2	1/4	1/6	1/8	0
3	3	6	9	1/2	1/5	1/8	2/1	2/4	2/7	0
4	4	8	1/2	1/6	2/0	2/4	2/8	3/2	3/6	0
5	5	1/0	1/5	2/0	2/5	3/0	3/5	4/0	4/5	0
6	6	1/2	1/8	2/4	3/0	3/6	4/2	4/8	5/4	0
7	7	1/4	2/1	2/8	3/5	4/2	4/9	5/6	6/3	0
8	8	1/6	2/4	3/2	4/0	4/8	5/6	6/4	7/2	0
9	9	1/8	2/7	3/6	4/5	5/4	6/3	7/2	8/1	0

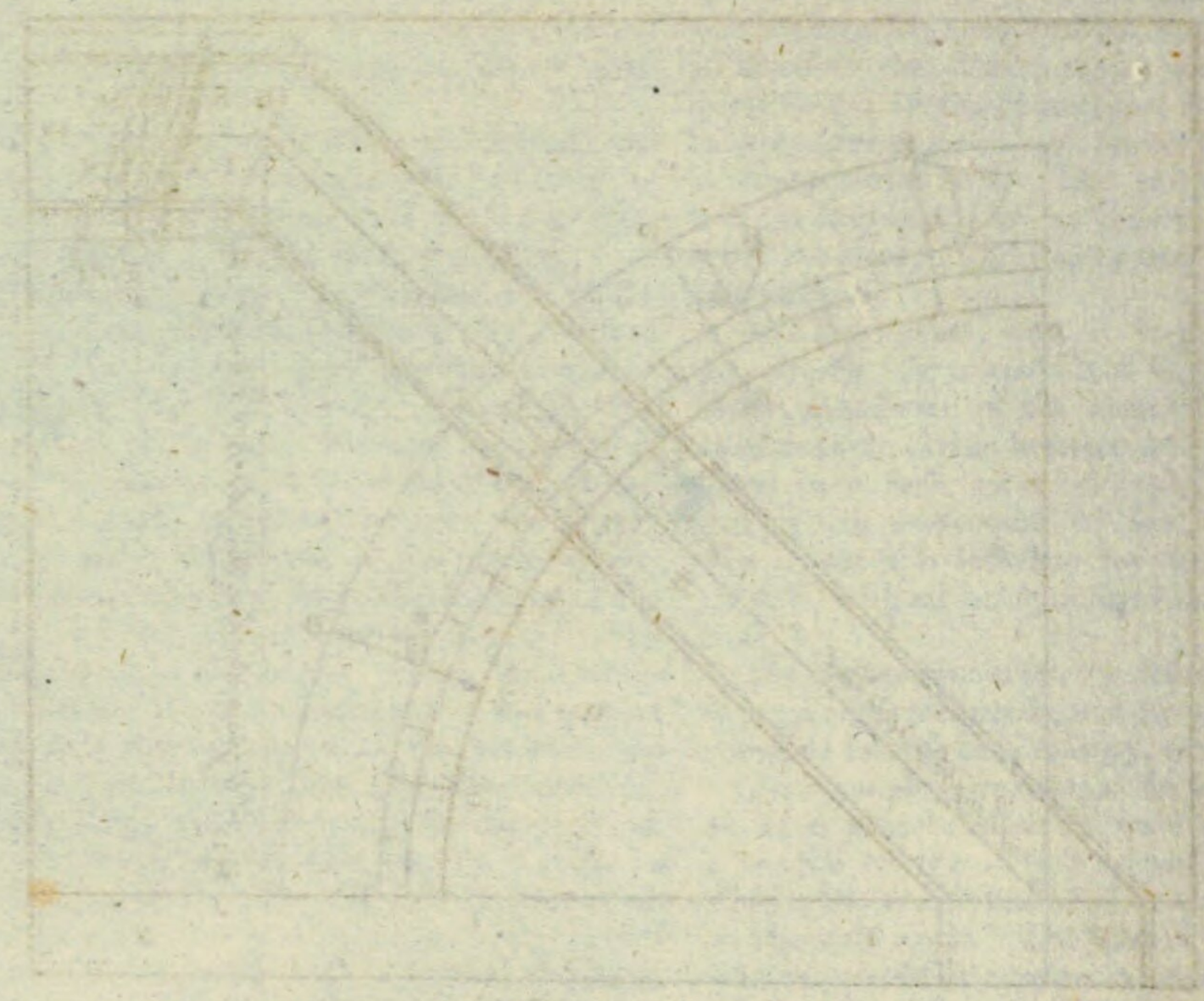
N.o 2

1	4	7	6	8
2	8	1/4	1/2	1/6
3	1/2	2/1	1/8	2/4
4	1/6	2/8	2/4	3/2
5	2/0	3/5	3/0	4/0
6	2/4	4/2	3/6	4/8
7	2/8	4/9	4/2	5/6
8	3/2	5/6	4/8	6/4
9	3/6	6/3	5/4	7/2

Nebel.



A. Bell Prin. Wal. Sculptor fecit.



Nauſcopy.

Nauſea, Nautilus.

ſelf) is the plaineſt thing he has ſaid, in order to make it be underſtood that he hath not made this diſcovery by the knowledge of any art or ſcience, which had been the object of his application, or of his former ſtudies.

"It is according to him the effect of chance; he hath taken nature in the act, and hath diſcovered his ſecret; ſo that his ſcience, or rather the firſt elements of it, hath not coſt him the leaſt trouble: but the thing which hath coſt him a great deal of labour, and which may be really called his own, is the art of judging of the exact diſtance.

"According to him, the ſigns very clearly indicate the preſence of ſhips; but none but thoſe who can well read theſe ſigns can draw any concluſions from them with regard to diſtances; and this art of reading them well, is, according to him, a true and a very laborious ſtudy: for this reaſon he hath himſelf, for a very long time, been the dupe of his ſcience. It is at leaſt 15 years ſince he firſt foretold here the arrival of ſhips. At firſt this was regarded only as a frolic. Wagers were laid on both ſides. He often loſt, becauſe the ſhips did not arrive at the time preſcribed by him. From thence came his application to find out the cauſe of theſe miſtakes; and the perfection of his art is the reſult of this application.

"Since the war, his informations have greatly increaſed, and probably were ſufficiently exact to excite the attention of the public. The noiſe of them reached us with the degree of enthuſiaſm which is always excited by the marvellous. He himſelf ſpoke of the reality of his ſcience with the tone of a man convinced. It would have been too cruel to have diſmiſſed him as a viſionary.

"Beſides, every thing depended upon proofs, and we required that he ſhould produce ſome: in conſequence, he hath regularly ſent us, for eight months, the informations which he thought he might venture to ſend us; and the reſult is, that ſeveral of the ſhips he announced are arrived at the time he foretold, after ſeveral days of information.

"Others have come later than was expected, and ſome have not appeared at all.

"With regard to ſome of theſe, it hath been aſcertained, that their delay had been occaſioned by calms or by currents. M. Bottineau is perſuaded, that thoſe which never appeared were foreign veſſels which went on; and accordingly we have learned, that ſome Engliſh ſhips were arrived in India, which might perhaps have been in ſight of the iſland at the time indicated. But this is no more than a conjecture, which our occupations have not allowed us to inveſtigate What we can aſcertain is, that in general it appears that M. Bottineau hath made juſt obſervations: whether it is owing to chance or to his abilities, it might be, perhaps, imprudent to determine. It is however certain, that the fact is ſo extraordinary, under whatever light it is conſidered, that we have not thought ourſelves able either to affirm or deny it; and we have wiſhed the Sieur Bottineau to compel us to take one or the other ſide of the queſtion, by truſting his ſecret to ſome truſty and able perſon.—But this he hath refuſed, being probably afraid that he ſhould not acquire by the diſcovery all the benefit which he imagines he may reap from it.

"Suppoſing the reality of the diſcovery, we do not believe that its utility can be as important as M. Bottineau perſuades himſelf it is; but it might perhaps throw a great light upon natural hiſtory. In order to be uſeful, it would be neceſſary that the diſcovery ſhould be confined to one nation, and remain unknown to all others. This will be impoſſible, if every fleet, every veſſel, and every privateer, is obliged to carry a man on board who is in poſſeſſion of this ſecret.—We remain, with reſpect, my Lord, your's, &c. Le Vte. de Souillac, Chevreau."

NAUSEA, or SICKNESS; a retching or propenſity and endeavour to vomit, ariſing from ſomething which irritates the ſtomach.

NAUTILUS, in zoology; a genus belonging to the order of vermes teſtacea. The ſhell conſiſts of one ſpiral valve, divided into ſeveral apartments by partitions. There are 17 ſpecies, chiefly diſtinguiſhed by particularities in their ſhells.

Bonani obſerves, that this genus of ſhell-fiſh is very well named from the Greek ναυτιλος, which ſignifies both "a ſhip" and "a ſailor;" for that the ſhells of all the nautili carry the appearance of a ſhip with a very high poop. Different authors, both ancient and modern, have called the nautilus by the names of *pompilus*, *nauplius*, *nauticus*, *ovum polypi*, *polypus teſtaceus*: and the French call it *le voilier*. It is by ſome imagined, that men firſt learned the art of navigation from this animal.

The moſt remarkable diviſion of the nautili is into the thin and thick-ſhelled kinds. The firſt is called *nautilus papyraceus*; and its ſhell is indeed no thicker than a piece of paper when out of the water. This ſpecies is not at all faſtened to its ſhell; but there is an opinion, as old as the days of Pliny, that this creature creeps out of its ſhell, and goes on ſhore to feed. When this ſpecies is to ſail, it expands two of its arms on high, and between theſe ſupports a membrane, which it throws out on this occaſion: this ſerves for its ſail, and the two other arms it hangs out of its ſhell, to ſerve occaſionally either as oars or as a ſteerage; but this laſt office is generally ſerved by the tail. When the ſea is calm, it is frequent to ſee numbers of theſe creatures diverting themſelves in this manner: but as ſoon as a ſtorm riſes, or any thing gives them diſturbance, they draw in their legs, and take in as much water as makes them ſpecifically heavier than that in which they float; and then they ſink to the bottom. When they riſe again, they void this water by a number of holes, of which their legs are full. The other nautilus, whoſe ſhell is thick, never quits that habitation. This ſhell is divided into 40 or more partitions, which grow ſmaller and ſmaller as they approach the extremity or centre of the ſhell: between every one of theſe cells and the adjoining ones there is a communication by means of a hole in the centre of every one of the partitions. Through this hole there runs a pipe of the whole length of the ſhell. It is ſuppoſed by many, that by means of this pipe the fiſh occaſionally paſſes from one cell to another; but this ſeems by no means probable, as the fiſh muſt undoubtedly be cruſhed to death by paſſing through it. It is much more likely that the fiſh always occupies the largeſt chamber in its ſhell; that is, that it lives in the cavity between the mouth and the firſt parti-

Nautilus, Navy.

tion, and that it never removes out of this; but that all the apparatus of cells, and a pipe of communication which we ſo much admire, ſerves only to admit occaſionally air or water into the ſhell, in ſuch proportion as may ſerve the creature in its intentions of ſwimming.

Some authors call this ſhell the *concha margaritifera:* but this can be only on account of the fine colour on its inſide, which is more beautiful than any other mother-of-pearl; for it has not been obſerved that this ſpecies of fiſh ever produced pearls. It muſt be obſerved, that the polypus is by no means to be confounded with the paper-ſhelled nautilus, notwithſtanding the great reſemblance in the arms and body of the incloſed fiſh; nor is the cornu ammonis, ſo frequently found foſſile, to be confounded with the thick-ſhelled nautilus, though the concamerations and general ſtructure of the ſhell are alike in both; for there are great and eſſential differences between all theſe genera. There is a pretty copious and minute account of this curious animal in the Gentleman's Magazine, vol. xxii. p. 6. 7. 8. and 301. and vol. xxv. p. 128.

NAVY, the fleet or ſhipping of a prince or ſtate. See MARINE.

The management of the Britiſh navy-royal under the lord high admiral of Great Britain, is entruſted to principal officers and commiſſioners of the navy, who hold their places by patent. The principal officers of the navy are four, viz. the treaſurer, whoſe buſineſs it is to receive money out of the exchequer, and to pay all the charges of the navy, by warrant from the principal officers: comptroller, who attends and controuls all payment of wages, is to know the rates of ſtores, to examine and audit all accounts, &c.: ſurveyor, who is to know the ſtates of all ſtores, and ſee wants ſupplied; to eſtimate repairs, charge boatſwains, &c. with what ſtores they receive, and at the end of each voyage to ſtate and audit accounts: clerk of the acts, whoſe buſineſs it is to record all orders, contracts, bills, warrants, &c.

The commiſſioners of the navy are five: the firſt executes that part of the comptroller's duty which relates to the comptrolling the victualler's accounts; the ſecond, another part of the ſaid comptroller's duty relating to the account of the ſtorekeepers of the yard; the third has the direction of the navy at the port of Portſmouth; the fourth has the ſame at Chatham; and the fifth at Plymouth. There are alſo other commiſſioners at large, the number more or leſs according to the exigencies of public affairs; and ſince the increaſe of the royal navy, theſe have ſeveral clerks under them, with ſalaries allowed by the king.

The victualling of the royal navy hath formerly been undertaken by contract; but is now managed by commiſſioners, who hold their office on Tower-hill, London. The navy-office is where the whole buſineſs concerning the navy is managed by the principal officers and commiſſioners.

The royal navy of Great Britain is now in a very flouriſhing ſtate, having been diligently kept up in late reigns, as the natural ſtrength of the kingdom. When it is complete, it is divided into three ſquadrons, diſtinguiſhed by the colours of the flags carried by the reſpective admirals belonging to the ſame, viz. *red*, *white*, and *blue*; the principal commander of which bears the title of *admiral:* and each has under him a vice-admiral and a rear-admiral, who are likewiſe flag-officers.

Navy || Naxia.

Navy Exerciſe. See EXERCISE.

Navy-Diſcipline, or *Regulations*. See *MARITIME-State*.

NAWORTH-CASTLE, in Cumberland, 10 miles from Carliſle, near the Gelt. This caſtle is ſtill entire and inhabited. It is a large pile, ſquare, and built round a court. On the north it ſtands over the river Ithing, at a great height, the banks ſhagged with wood. The whole houſe is a very irregular building, the rooms numerous, acceſſible by 16 ſtaircaſes, with moſt frequent and ſudden aſcents and deſcents, &c.— The great hall has a gallery at one end, adorned with four vaſt creſts carved in wood, viz. a griffin and dolphin, with the ſcollops; an unicorn, and an ox with a coronet round his neck. In front is a figure in wood of an armed man; two others, perhaps vaſſals, in ſhort jackets and caps; a pouch pendant behind, and the mutilated remains of Priapus to each; one has wooden ſhoes. Theſe ſeem the *ludibrium aulæ* in thoſe groſs days. The top and upper end of the room is painted in ſquares, to the number of 107, repreſenting the Saxon kings and heroes. The chimney here is five yards and a half broad. Within this is another apartment, hung with old tapeſtry, a head of Ann of Cleeves; on one ſide of her a ſmall picture of a lady in full length, &c. and many others. Many of theſe paintings were brought from Kirk-Oſwald-caſtle when that was demoliſhed. The chapel has a cieling, and part of its wainſcot of the ſame kind, being paintings of Patriarchs, Jewiſh kings, &c. It has a floor of plaſter of Paris, as have ſome other of the rooms. Some of the apartments are very large and ſpacious. The ſmall Popiſh chapel is above ſtairs, and joining to this chapel is the library, which has a wooden roof; the books are old, there are not above one or two of the manuſcripts here now. This caſtle was built by one of the Dacre's, about the reign of Henry III. In the garden walls were ſtones with Roman inſcriptions, which the late earl of Carliſle gave to Sir Thomas Robinſon, and were by him removed to his muſeum at Rookſby: On one of theſe ſtones is this inſcription, *peditum centum quinquaginta Britannorum;* whence it appears that the Romans, when in poſſeſſion of Britain, ſometimes indulged the national troops with the favour of garriſoning their own territories.

NAXIA, or NAXOS, a conſiderable iſland of the Archipelago, 25 miles in length, and 88 in circumference. The whole iſland is covered with orange, olive, lemon, cedar, citron, pomegranate, fig, and mulberry trees; and there are a great many ſprings and brooks. This iſland has no harbour; and yet they carry on a conſiderable trade in barley, wine, figs, cotton, ſilk, flax, cheeſe, ſalt, oxen, ſheep, mules, and oil. They burn only oil of maſtic, though olive-oil is exceeding cheap. It is inhabited both by Greeks and Latins, who live in great dread of the Turks: for when the meaneſt of their ſhips appear here, they always wear red caps like galley-ſlaves, and tremble before the loweſt officer; but as ſoon as they are gone, they put on their caps of velvet. The ladies are ſo vain, that when they return out of the country, they

Naxos, Naxus.

they have 40 women in their train, half on foot and half on aſſes; one of whom carries a napkin or two, another a petticoat, another a pair of ſtockings, and ſo on; which is a very ridiculous ſight to ſtrangers. There are four archbiſhops ſees in this iſland, and a great many villages; but ſo thin of people, that the whole iſland does not contain above 8000 inhabitants. The higheſt mountain is *Zia*, which ſignifies "the mountain of Jupiter." There are but few antiquities, except ſome ſmall remains of the temple of Bacchus. Some ſay they have mines of gold and ſilver; however, there is one of emery, which is ſo common here, and ſo cheap, that the Engliſh often ballaſt their ſhips therewith.

NAXOS, or *Naxia*, a conſiderable town, and capital of the iſle of Naxos, over-againſt the iſle of Paros, with a caſtle and two archbiſhops ſees, the one Greek and the other Latin. The greateſt part of the inhabitants are Greeks. E. Long. 25. 51. N. Lat. 37. 8.

NAXUS, now NAXIA, formerly *Strongyle*, *Dia*, *Dionyſias*, *Callipolis*, and *Little Sicily*. It was called *Strongyle*, from a Greek word, ſignifying "round," though in reality it is rather ſquare than round. The names of *Dia* or *Divine*, and *Dionyſias*, were given it as being conſecrated in a peculiar manner to the fabulous god Dionyſus or Bacchus. The appellation of *Callipolis* Pliny and Solinus derive from the metropolis of the iſland, formerly a moſt beautiful city, which is the import of the word Callipolis. The great fertility of the country gave riſe to the name of *Little Sicily*, Naxus being the moſt fruitful of all the Cyclades, as Agathemerus informs us, and no leſs fertile than Sicily itſelf. As for the name of *Naxus*, ſome aſſert that it was borrowed from one Naxus, under whoſe conduct the Carians poſſeſſed themſelves of the iſland; others pretend it received its name from Naxus, the ſon of Endymion. Stephanus, Suidas, and Phavorinus, derive the name of *Naxos* from the Greek word *naxai*, ſignifying "to ſacrifice," and will have it to have been ſo called from the many ſacrifices offered here to Bacchus. With theſe Bocchart agrees, as to its being called *Naxos* from the ſacrifices performed here in honour of Bacchus, but will have the word *naxos* to be a corruption of the Phœnician *nacſa*, or *nicſa*, ſignifying "a ſacrifice, offering." Naxos is, according to Pliny, 75, but reckoned by the preſent inhabitants 100, miles in compaſs. It has Paros to the weſt, Myconos and Delos to the north, and Ios to the ſouth. This iſland is the moſt fruitful of the Archipelago, and was formerly famed for the excellent wines it produced. Archilochus, as quoted by Athenæus, compares them to the nectar of the gods; and Aſclepiades, cited by Stephanus, aſſures us, that Bacchus took more delight in Naxos than in any other place whatſoever, having himſelf taught the inhabitants to cultivate their vines. The wine of Naxos maintains to this day its ancient reputation, being by ſome deemed the beſt of the Levant. Beſides wine, this iſland abounds with all ſorts of delicious fruits, the plains being covered with orange, olive, lemon, cedar, citron, pomegranate, mulberry, and fig trees. It was formerly famous for quarries of that ſort of marble which the Greeks called *ophites*, from its being green, and ſpeckled with white ſpots like the ſkin of a ſerpent. The beſt emerald is found here on mountains near the weſtern coaſt, whence the neighbouring cape is called by the Italians *capo ſmeriglio*, or the emerald cape. As to the inhabitants of Naxos, Diodorus relates that the iſland was firſt peopled by the Thracians. Theſe were in a little time ſubdued by a body of Theſſalians, who having poſſeſſed the iſland for the ſpace of 200 years and upwards, were compelled to abandon it by a drought and famine.

Naxus, Naylor.

After the Trojan war, the Carians ſettled here and called the iſland *Naxos*, from their king, who was the ſon of Polemon. He was ſucceeded by his ſon Leucippus, and Leucippus by his ſon Smardius, in whoſe reign Theſeus, coming out of Crete, landed here with Ariadne, whom he was, in his ſleep, commanded by Bacchus to leave in this iſland. In proceſs of time a colony of Cnidians and Rhodians ſettled here under the conduct of Hippothous and Xuthus; the laſt of all the Ionians, who, in time, poſſeſſed the whole iſland; whence the Naxians are, by Herodotus, called *Ionians*, and ranked among the Athenian colonies. E. Long. 26. 5. N. Lat. 36. 30. It is about 105 miles in circumference and about 30 broad.

NAXUS, (anc. geog.), a town of Crete, famous for its hones, called *lapis Naxius*. Another of Sicily, built by the Chalcidian; ſituated on the ſouth ſide of Mount Taurus, deſtroyed by Dionyſius the tyrant; from whoſe ruins Tauromenium, built by Timoleon, either aroſe or was increaſed, (Plutarch).

NAYLOR (James), a noted Engliſh enthuſiaſt, was born, about 1616, in the pariſh of Ardeſley, not far from Wakefield in Yorkſhire. His father, though a farmer, and the proprietor of an eſtate, gave his ſon but a mean education; which is perhaps to be regretted, for his parts were very conſiderable. He married when very young and ſettled in Wakefield pariſh. In 1641 he was a private ſoldier under Lord Fairfax, being then a preſbyterian: but he afterwards became an independent, and was made quarter-maſter under General Lambert. In 1651-2, he was converted by George Fox the apoſtle of the quakers, and ſoon commenced a preacher and prophet among that people. One of his prophecies was, that the laſt and general judgment ſhould be on the 15th day of the enſuing November. The falſehood of this prediction was ſoon perceived, and of courſe his impoſture ought to have been detected; but ſuch is the power of enthuſiaſm over the human mind, that his fame roſe daily; and upon his going to London in 1655, he excited to no common pitch the envy of his brethren. He had ſtrange fancies of celeſtial illuminations, and conſidered himſelf as a great favourite of heaven. In 1656 he went into the weſt of England, but his extravagancies were ſo great and his opinions ſo blaſphemous, that even in thoſe days of fanatical deluſion, they were heard with ſuch horror, that the author of them was impriſoned in Exeter gaol; from which however he was relieved in the ſpace of a month. Upon this he determined to return to London; but taking Briſtol in his way, he made his entrance into that city in imitation of our Saviour's entrance into Jeruſalem, the people ſtrewing the way, &c. and calling out "Holy, holy, holy, lord god of Sabaoth; hoſanna in the higheſt, &c." So impious a conduct

Nayres, Nazareth.

could not eſcape animadverſion: he was apprehended with ſix of his aſſociates. On examination he defended all that had paſſed; and was ſoon after with his followers ſent to London, impriſoned, and condemned to be whipt, and then put to hard labour. The ſentence, though much petitioned againſt, was executed, and he recovered his ſenſes, expreſſed his repentance, and was again received by the Quakers, who, during his impious frenzy, had diſowned him. In 1659 he was freed from priſon; and the following year ſet off to ſee his wife and children; but being robbed and left bound by the way, he was found in that ſtate and carried to a friend's houſe at Rippon, where he died in November 1660. He was accounted the author of ſeveral works. His eccentricities, however, rather than his writings, have preſerved his character; and he ſtands forward to the world, not ſo much as a man of genius or parts, though he was in ſome meaſure poſſeſſed of both, but rather as a ſtriking example of the power of enthuſiaſm over the human mind, and of the danger of giving way to the religious reveries of an overheated imagination.

NAYRES, the nobility of the Malabar coaſt. We may with truth affirm that they are the oldeſt nobility in the world; for the moſt ancient writers mention them, and quote the law that permits the Nayre ladies to have many huſbands; every one being allowed four. Their houſes, which ſtand ſingle, have as many doors as the lady has huſbands. When one of them viſits her, he walks round the houſe, ſtriking with his ſabre on his buckler: he then opens his door, and leaves a domeſtic with his arms in a kind of porch, who ſerves to inform others that the lady is engaged. It is ſaid, that one day in the week the four doors are all opened, and all her huſbands viſit her, and dine together with her. Each huſband gives a ſum of money, or portion, at the time of marriage; and the wife only has the charge of the children. The Nayres, even the Samorin, and the other princes, have no other heirs than the children of their ſiſters. This law was eſtabliſhed, that the Nayres, having no family, might be always ready to march againſt the enemy. When the nephews are of age to bear arms, they follow their uncles. The name of *father* is unknown to a Nayre child. He ſpeaks of the huſbands of his mother and of his uncles, but never of his father.

NAZARETH, a little city in the tribe of Zebulun, in Lower Galilee, to the weſt of Tabor, and to the eaſt of Ptolemais. Euſebius ſays, it is fifteen miles from Legion towards the eaſt. This city is much celebrated in the ſcriptures, for having been the uſual place of the reſidence of Jeſus Chriſt for the firſt 33 years of his life. Luke ii. 51. It was there our Saviour became incarnate, where he lived in obedience to Joſeph and Mary, and from whence he took the name of a Nazarean. After he had begun to execute his miſſion, he preached there ſometimes in the ſynagogue, *id.* iv. 16. But becauſe his countrymen had no faith in him, and were offended at the meanneſs of his original, he did not many miracles there, Matth. xiii. 54. 58 nor would he dwell therein; ſo he fixed his habitation at Capernaum for the latter part of his life, *id.* iv. 13. The city of Nazareth was ſituated upon an eminence; and on one ſide there was a precipice, from whence the Nazareans one day had a deſign of throwing down our Saviour, becauſe he upbraided them with their incredulity, Luke iv. 29. Nazareth.

St Epiphanius ſays, that in his time Nazareth was only a village, and that to the reign of Conſtantine it was inhabited by Jews alone, excluſive of all Chriſtians. Adamnanus, a writer of the ſeventh age, ſays, that in his time there were two great churches to be ſeen at Nazareth, one in the midſt of the city, built upon two arches, in the place where our Saviour's houſe had ſtood. Under the two arches now mentioned, was a very fine fountain, which furniſhed water to the whole city, and from whence water was drawn alſo by the help of a pulley for the uſe of the church above. The ſecond church of Nazareth was built in a place where the houſe ſtood wherein the angel Gabriel revealed to the virgin Mary the myſtery of our Lord's incarnation; and we are aſſured that the church of incarnation, which is ſupported by two arches, is ſtill in being to this day. Mr Maundrell tells us, that there is a convent built over what is ſaid to be the place of annunciation; for the chamber where ſhe received the angel's ſalutation was about 500 years ago removed from Nazareth, and, according to the Roman legends, tranſported by angels to Loretto, then a ſmall village in the pope's dominions, now become a biſhop's ſee.—However, Calmet's opinion (which is certainly the true one) upon the different tranſlations of this famous houſe of Loretto is, that they were no other than ſo many different buildings made upon the model of the church of Nazareth, juſt as in ſeveral places ſepulchres have been built upon the model of that at Jeruſalem. Mariti tells us, that in the eaſtern part of the city ſtands the church dedicated to the Bleſſed Virgin: the zeal of the Cœnobites raiſed it from the ruins of that which had been deſtroyed by the Saracens. It is a very handſome building, and conſiſts of three naves; in the middle of which is the principal altar; to which there is an aſcent by two magnificent ſtairs, much admired for their iron balluſtrades, the work of an ingenious monk of the convent. The deſcent to the grotto or annunciation chapel below is by ſteps of beautiful marble, cut with great taſte. Two beautiful columns of oriental granite ſtrike the eye of the obſerver in the entrance. They appear to have been conſtructed both to ſupport and ornament the grotto. The altar of this ſubterranean chapel is extremely elegant; and the different kinds of marble with which it is ornamented, receive an additional luſtre from the combined light of ſeveral ſilver lamps preſented by Chriſtian princes. On ſolemn feſtivals, the walls and the pilaſters are ornamented with various pieces of tapeſtry, repreſenting the myſteries of the Virgin; a ſuperb preſent from the Houſe of Auſtria. In the weſtern part of the city ſtands a Chriſtian church, built, as is ſaid, on the ſite of the ancient ſynagogue where Jeſus ſhowed the Jews the accompliſhment of the prophecies in his perſon. This place ſerved a long time as a ſhelter for flocks, but at preſent it is in good repair. In the neighbourhood may be ſeen a fountain of excellent water, which is, however, eſteemed by the people on another account. They conjecture that it was contiguous to the habitation of the Virgin, and that it was uſed by her. At ſome diſtance is a large ſtone of a round form, called *Chriſt's Table.* It is pretended

Nazarite. pretended that he came hither more than once with his diſciples to eat. The inhabitants of Nazareth pay it a kind of worſhip, by burning perfumes and incenſe around it. It is ſituated in 35° E. Long. and in 32° N. Lat; and formerly held the third rank under the patriarch of Jeruſalem. At preſent it is part of the domains of the chief of Acre. The ancient city, after the ravages of fanaticiſm, was reduced to a miſerable hamlet, containing only a few Arab huts. Under the protection of Daher Omar, however, it recovered very conſiderably, and is now of far more importance.

NAZARITE, or NAZAREAN, or *Nazarines*, a term which may ſignify, 1. One that is of Nazareth, or any native of this city. 2. It was given to Jeſus Chriſt and his diſciples, and is commonly taken in a ſenſe of deriſion and contempt, in ſuch authors as have written againſt Chriſtianity. 3. It has been taken for a ſect of heretics called Nazareans. 4. For a Nazarite, a man that has laid himſelf under the obligation of a vow to obſerve the rules of Nazariteſhip, whether it be for his whole life, as Sampſon and John the Baptiſt, or only for a time, as thoſe mentioned in Numbers vi. 18, 19, 20. Amos ii. 11, 12. Laſtly, the name Nazarite in ſome paſſages of ſcripture denotes a man of particular diſtinction and great dignity in the court of ſome prince. But we muſt ſpeak of theſe ſeveral ſorts of Nazarites ſomething more diſtinctly.

The name of Nazarene belongs to Jeſus Chriſt, not only becauſe of his having lived the greateſt part of his life at Nazareth, and becauſe this city has always been conſidered as his country, but alſo becauſe the prophets had foretold that he ſhould be called a Nazarene, Matth. ii. 23. "And he came and dwelt in a "city called Nazareth, that it might be fulfilled which "was ſpoken by the prophets, He ſhall be called a "Nazarene." We find no particular place in the prophets in which it is ſaid that the Meſſiah ſhould be called a Nazarene; and St Matthew only quotes the prophets in general. Perhaps he would inſinuate, that the conſecration of the Nazarites, and the great purity of which they made profeſſion, was a type and a ſort of prophecy of thoſe of our Saviour, or elſe that the name נזיר *Nazir* or *Nazarite* given to the patriarch Joſeph, Gen. xlix. 26. Deut. xxxiii. 16. was a prophecy which was to be fulfilled in the perſon of Jeſus Chriſt, of whom Joſeph was a figure. Laſtly, St Jerom was of opinion, that St Matthew here alludes to that paſſage of Iſaiah xi. 1. and lx. 21. "And there ſhall come forth a rod out of the ſtem "of Jeſſe, and a branch (in Hebrew *Nezer*) ſhall grow "out of his roots." This branch or *Nezer*, and this rod, are certainly intended to denote Jeſus Chriſt, by the general conſent of all the fathers and interpreters.

When the word Nazarean is put for the heretics known by this name, it denotes Chriſtians converted from Judaiſm, whoſe chief error conſiſted in defending the neceſſity or expediency of the works of the law, and who obſtinately adhered to the practice of the Jewiſh ceremonies. The name of Nazarenes at firſt had nothing odious in it, and it was often given to the firſt Chriſtians. The fathers frequently mention the goſpel of the Nazarenes, which differs nothing from that of St Matthew, which was either in Hebrew or Syriac, for the uſe of the firſt converts, but was afterwards corrupted by the Ebionites. Theſe Nazareans preſerved this firſt goſpel in its primitive purity. Some of them were ſtill in being in the time of St Jerom, who does not reproach them with any error. They were very zealous obſervers of the law of Moſes, but had the traditions of the Phariſees in very great contempt. Nazarite.

Nazarite, when put to ſignify thoſe under the ancient law who made a vow of obſerving a more than ordinary degree of purity (Numb. *ubi cit.*), denotes a man or woman who engage themſelves by a vow to abſtain from wine and all intoxicating liquors, to let their hair grow without cutting or ſhaving, not to enter into any houſe that was polluted by having a dead corpſe in it, nor to be preſent at any funeral. And if by chance any one ſhould have died in their preſence, they began again the whole ceremony of their conſecration and Nazariteſhip. This ceremony generally laſted eight days, ſometimes a month, and ſometimes their whole lives. When the time of their Nazariteſhip was accompliſhed, the prieſt brought the perſon to the door of the temple, who there offered to the Lord a he-lamb for a burnt-offering, a ſhe-lamb for an expiatory ſacrifice, and a ram for a peace-offering. They offered likewiſe loaves and cakes, with wine neceſſary for the libations. After all this was ſacrificed and offered to the Lord, the prieſt or ſome other ſhaved the head of the Nazarite at the door of the tabernacle, and burnt his hair, throwing it upon the fire of the altar. Then the prieſt put into the hand of the Nazarite the ſhoulder of the ram roaſted, with a loaf and a cake, which the Nazarite returning into the hands of the prieſt, he offered them to the Lord, lifting them up in the preſence of the Nazarite. And from this time he might again drink wine, his Nazariteſhip being now accompliſhed.

As to thoſe that were perpetual Nazarites, as were Samſon and John the Baptiſt, it appears that they were conſecrated to their Nazariteſhip by their parents, and continued all their lives in this ſtate, without drinking wine or cutting their hair.

Thoſe that made a vow of Nazariteſhip out of Paleſtine, and could not come to the temple when their vow was expired, contented themſelves with obſerving the abſtinence required by the law, and after that cutting their hair in the place where they were: as to the offerings and ſacrifices preſcribed by Moſes, which were to be offered at the temple by themſelves, or by others for them, they deferred this till they could have a convenient opportunity. Hence it was, that St Paul being at Corinth, and having made the vow of a Nazarite, he had his hair cut off at Cenchrea, and put off fulfilling the reſt of his vow till he ſhould arrive at Jeruſalem, Acts xviii. 18. When a perſon found that he was not in a condition to make a vow of Nazariteſhip, or had not leiſure to perform the ceremonies belonging to it, he contented himſelf by contributing to the expence of the ſacrifice and offerings of thoſe that had made and fulfilled this vow; and by this means he became a partaker in the merit of ſuch Nazariteſhip. When St Paul came to Jeruſalem, in the year of Chriſt 58, the apoſtle St James the Leſs, with the other brethren, ſaid to him, Acts xxi. 23, 24. that to quiet the minds of the converted Jews, who had been a

Nazarite || Nealing.

been informed that he everywhere preached up the entire abolition of the law of Moſes, he ought to join himſelf to four of the faithful who had a vow of Nazariteſhip upon them, and contribute to the charge of the ceremony at the ſhaving of their heads; by which the new converts would perceive that he continued to keep the law, and that what they had heard of him was not true.

The Hebrew word *Nazir*, or Nazarite, which is made uſe of to expreſs a man exalted to great dignity, as it is ſaid of the patriarch Joſeph, Gen. xlix. 26. and Deut. xxxiii. 16. "that he was ſeparate from his brethren," as it is in our tranſlation; or as the Vulgate and others underſtand the Hebrew, "that he was "as a Nazarite among his brethren," is variouſly underſtood. Some think that the Hebrew word נזיר *Nazir*, in theſe places, ſignifies one who is crowned, choſen, ſeparated, or diſtinguiſhed: the word נזיר *Nazir* ſignifies a crown. The Septuagint tranſlate this word a chief, or him that is honoured. Calmet thinks that this was a term of dignity in the courts of eaſtern princes; and that at this day in the court of Perſia the word *Nazir* ſignifies the ſuperintendant general of the king's houſehold, the chief officer of the crown, the high ſteward of his family, treaſures, and revenues; and that in this ſenſe Joſeph was the Nazir of the court of Pharaoh. Le Clerc tranſlates the *Nazir*, a prince, and calls Joſeph "the prince of his brethren," in the two places already quoted. Mr Pool declares in favour of this laſt tranſlation. See *Joſeph. Chardin. Chryſoſt. St Jerom, &c.*

NAZIANZEN. See *Gregory Nazianzen.*

NAZIM, the lord lieutenant, viceroy, or governor of a province in Hindoſtan; the ſame as *Lubahdar*, or *Nabob.*

NEALED, among ſeamen, is uſed when the ſounding is deep water cloſe to the ſhore; as alſo when the ſhore is ſandy, clayey, oozy, or foul and rocky ground.

NEALING, or rather Annealing, a term uſed for the preparing of ſeveral matters, by heating or baking them in the oven, or the like.

Nealing of glaſs, is the baking of glaſs, to dry, harden, and give it the due conſiſtence, after it has been blown, and faſhioned into the proper works.—This is uſually performed in a kind of tower called the *leer*, built over the melting furnace. See Glass.

Nealing of glaſs is alſo uſed for the art of ſtaining glaſs with metalline colours. "One fine uſe of ſilver (ſays Mr Boyle) was only diſcovered ſince the art of annealing upon glaſs came to be practiſed. For prepared ſilver, or even the crude metal, being burnt on a glaſs plate, will tinge it of a fine yellow or golden colour. And there are ſeveral mineral earths, and other courſe matters of uſe in this art, which by means of fire impart tranſparent colours to glaſs, and ſometimes very different ones from thoſe of the bodies themſelves.

Nealing of ſteel, is the heating it in the fire to a blood-red heat, and then taking it out, and letting it cool gently of itſelf. This is done to make it ſofter, in order to engrave or punch upon it. See Tempering and Engraving.

Nealing is alſo uſed for the art or act of burning or baking earthen or other ware in an oven. The miners at Mendip, when they meet with a rock they cannot cut through, anneal it by laying on wood and coal, and contriving the fire ſo that they quit the mine before the operation begins, it being dangerous to enter it again before it be quite cleared of the ſmoke.

Neap || Nebio.

Nealing of tile is uſed in ancient ſtatutes for the burning of tile. The word is formed of the Saxon *onælan, accendere*, to light, burn.

NEAP, or Neep-tides, are thoſe tides which happen when the moon is in the middle of the ſecond and fourth quarters. The neap-tides are low tides, in reſpect of their oppoſites the ſpring-tides. As the higheſt of the ſpring-tides is three days after the full or change, ſo the loweſt of the neap is four days before the full or change. On which occaſion the ſeamen ſay that it is deep neap.

NEAPED. When a ſhip wants water, ſo that ſhe cannot get out of the harbour, off the ground, or out of the dock, the ſeamen ſay ſhe is *neaped*, or *beneaped*.

NEAPOLIS (anc. geog.), a city of the Higher Egypt, in the Nomos Panopolitanus, between Thebæ to the ſouth, and Panopolis to the north, on the eaſt ſide of the Nile; otherwiſe called *Caene*.—A ſecond Neapolis of Babylonia, ſituated near the Euphrates on the ſouth ſide.—A third of Campania, an ancient town and a colony from Cumæ. (See Velleius, Pliny, Strabo); accounted a Greek city, and a great ſtickler for Greek uſages, (ſee Livy, Tacitus). Its hot baths were in nothing inferior to thoſe of Baiæ, according to Strabo: at two miles diſtance from it ſtands the monument of Virgil, held in religious veneration by learned poſterity. The Younger Pliny relates, that Virgil's birth-day was more religiouſly obſerved by Silius Italicus than his own, eſpecially at Naples, where he reſorted to his tomb as to a temple. The city is waſhed by the river Sebethus. Virgil feigns the nymph Sebethis to preſide over the ſtream. Now *Naples*, capital of the kingdom of that name. See Naples.—A fourth, Neapolis of Caria, near the Meander, (Ptolemy).—A fifth, an inland town of Cyrenaica, ſituated between Ptolemais and Arſinoe, (Ptolemy); and to be diſtinguiſhed from the Cænopolis, or Neapolis, on the eaſt border of the ſame province, (id). A ſixth of Ionia, (Strabo); which belonged firſt to the Epheſians, but afterwards to the Samians, who exchanged Maratheſium, a more diſtant city, for a nearer.—A ſeventh, Neapolis of Macedonia Adjecta, ſituated at the diſtance of 12 miles to the eaſt of Philippi, (Antonine).—An eighth, Neapolis of Piſidia, on the borders of Galatia, ſituated between Amblada and Pappa, (Ptolemy).—A ninth, of Samaria, the ancient *Sichem*, which ſee; ſo called upon its reſtoration by the Romans, (Coin, Pliny, Joſephus).—A tenth, of Sardinia, ſituated on the ſouth-weſt ſide of the iſland, 30 miles to the north of Metalla; now called *Neapoli*.—An eleventh, of the Regio Syrtica, called alſo *Leptis*.—A twelfth, of Zeugitana on the Mediterranean, to the eaſt of Clypea, and ſouth of the Promontorium Mercurii.

NEAT, or *Net Weight*, the weight of a commodity alone, clear of the caſk, bag, caſe, or even filth. See Net.

NEBIO, or Nebbio, a ruined city of Italy, on the north

Nebo || Neceſſity.

north ſide of the iſland of Corſica, with a biſhop's ſee, whoſe biſhop reſides at San Florenzo, from which it is a mile diſtant.

NEBO, (anc. geog.), a very high mountain, a part of the mountains Abarim, and their higheſt top, whither Moſes was ordered to aſcend to take a view of the land of Canaan, and there die. Situated in the land of Moab, over-againſt Jericho: with a cognominal town at its foot (Iſaiah) belonging to the Reubenites, which afterwards returned to the Moabites; in Jerome's time deſolate; eight miles to the ſouth of Heſhbon.

NEBO, or *Nabo*. See NABO.

NEBUCHADNEZZAR. See NABUCHADNEZZAR.

NEBULY, or NEBULEE, in heraldry, is when a coat is charged with ſeveral little figures, in form of words running within one another, or when the outline of a bordure, ordinary, &c. is indented or waved.

NECESSITY, whatever is done by a cauſe or power that is irreſiſtible; in which ſenſe it is oppoſed to freedom. Man is a neceſſary agent, if all his actions be ſo determined by the cauſes preceding each action, that not one paſt action could poſſibly not have come to paſs, or have been otherwiſe than it hath been; nor one future action can poſſibly not come to paſs, or be otherwiſe than it ſhall be. But he is a free agent, if he be able, at any time, under the circumſtances and cauſes he then is, to do different things; or, in other words, if he be not unavoidably determined in every point of time, by the circumſtances he is in, and the cauſes he is under, to do that one thing he does, and not poſſibly to do any other thing. Whether man is a neceſſary or a free agent, is a queſtion which has been debated with much ingenuity by writers of the firſt eminence, from Hobbes and Clarke, to Prieſtley and Gregory. See METAPHYSICS, Part III. chap. 5. and PREDESTINATION.

NECESSITY, in mythology, a power ſuperior to all other powers, and equally irreſiſtible by gods and by men. Herodotus, as he is quoted by Cudworth, mentions an oracle which declared that "God himſelf could not ſhun his deſtined fate." And among the fragments of Philemon collected by Le Clerc, is the following ſentence:

Δουλοι βασιλειων εσμεν, οἱ βασιλεις θεων, ὁ θεος αναγκης.

"We are ſubject to kings, kings to the gods, and God to neceſſity." Hence it is, that, in the Iliad, we find Jove himſelf, the ſire of gods and men, regretting that he was reſtrained by *neceſſity* from reſcuing his favourite ſon from the ſword of Patroclus. Nay to ſuch a height was this impiety carried in the earlieſt ages of Greece, that we find Heſiod and Homer teaching that the gods themſelves were generated by *neceſſity*, of night and chaos.

This power, though always repreſented as blind and unintelligent, was however worſhipped as a goddeſs, bearing in her hand large iron-nails, wedges, anchors, and melted lead *, as emblems of the inflexible ſeverity of her nature. "In the city of Corinth ſhe had a temple, in which the goddeſs *Violence* likewiſe reſided, and into which no perſon was ever permitted to enter but the prieſt who officiated *in ſacris* †."

Learned men have exerciſed their ingenuity in vain attempts to trace this portentous notion to its origin. Some, who wiſhed to interpret it in a pious ſenſe, have ſuppoſed that the gods who were ſubject to *neceſſity* were only thoſe who were the miniſters of the ſupreme *numen*; and that by *neceſſity* itſelf was meant nothing more than divine providence. But this is not conſiſtent with Heſiod and Homer's generation of the gods, or with the epithets *ſæva neceſſitas*, *dura neceſſitas*, by which this power was perpetually diſtinguiſhed. Others, and among them Moſheim, have ſuppoſed that this monſtrous fable was invented by the pagan prieſts, and diligently inculcated upon the minds of the people, in order to excuſe the villanies of the objects of their worſhip. For, ſays he, who could be indignant at Jupiter's numberleſs adulteries, after it was known that in all his actions he was the ſervant of blind neceſſity? In the thefts of *Mercury*, the whoredoms of *Venus*, and the frequent ſquabbles of the other gods, there could be no moral turpitude, if they were under the influence of a ſuperior power.

Numina cum videas duris obnoxia fatis,
Invidia poſſis exonerare deos ‡.

‡ *Martial. Epigram.* Lib ix. N. 88. Ed. Amſtel. 1701.

This account of the matter is at leaſt as plauſible as any other which is uſually given; but the real caſe undoubtedly was, that when men "did not like to retain God in their knowledge, God gave them over to a reprobate mind to do thoſe things which are not convenient; when their fooliſh heart was darkened, and profeſſing themſelves to be wiſe, they became fools." See PARCÆ.

Neceſſity.

NECESSITY, in law, as it implies a defect of will, excuſes from the guilt of crimes. See CRIME.

Compulſion and inevitable *neceſſity* are a conſtraint upon the will, whereby a man is urged to do that which his judgment diſapproves; and which, it is to be preſumed, his will (if left to itſelf) would reject. As puniſhments are therefore only inflicted for the abuſe of that free-will which God has given to man, it is highly juſt and equitable that a man ſhould be excuſed for thoſe acts which are done through unavoidable force and compulſion.

1. Of this nature, in the firſt place, is the obligation of *civil ſubjection*, whereby the inferior is conſtrained by the ſuperior to act contrary to what his own reaſon and inclination would ſuggeſt: as when a legiſlator eſtabliſhes iniquity by a law, and commands the ſubject to do an act contrary to religion or ſound morality. How far this excuſe will be admitted *in foro conſcientiæ*, or whether the inferior in this caſe is not bound to obey the divine rather than the human law, it is not our buſineſs to decide; though, among the caſuiſts, it is believed the queſtion will hardly bear a doubt. But, however that may be, obedience to the laws in being is undoubtedly a ſufficient extenuation of civil guilt before the municipal tribunal. The ſheriff who burnt Latimer and Ridley, in the bigotted days of Queen Mary, was not liable to puniſhment from Eliſabeth for executing ſo horrid an office; being juſtified by the commands of that magiſtracy which endeavoured to reſtore Superſtition, under the holy auſpices of its mercileſs ſiſter, Perſecution.

As to perſons in private relations, the principal caſe where conſtraint of a ſuperior is allowed as an excuſe for criminal miſconduct, is with regard to the matrimonial ſubjection of the wife to her huſband:

* *Horace*, Lib. i. Ode 35.

† *Pauſanias in Corinth.* Cap. 4.

for

Neceſſity. for neither a ſon nor a ſervant are excuſed for the commiſſion of any crime, whether capital or otherwiſe, by the command or coercion of the parent or maſter; though in ſome caſes the command or authority of the huſband, either expreſs or implied, will privilege the wife from puniſhment, even for capital offences. And therefore, if a woman commit theft, burglarly, or other civil offences againſt the laws of ſociety, by the coercion of her huſband, or even in his company, which the law conſtrues a coercion, ſhe is not guilty of any crime; being conſidered as acting by compulſion, and not of her own will. Which doctrine is at leaſt 1000 years old in this kingdom, being to be found among the laws of King Ina the Weſt-Saxon. And it appears, that, among the northern nations on the continent, this privilege extended to any woman tranſgreſſing in concert with a man, and to any ſervant that committed a joint offence with a freeman: the male or freeman only was puniſhed, the female or ſlave diſmiſſed; *procul dubio quod alterum libertas, alterum neceſſitas impelleret.* But (beſides that, in our law, which is a ſtranger to ſlavery, no impunity is given to ſervants, who are as much free agents as their maſters) even with regard to wives, this rule admits of an exception in crimes that are *mala in ſe,* and prohibited by the law of nature; as murder, and the like: not only becauſe theſe are of a deeper dye, but alſo, ſince in a ſtate of nature no one is in ſubjection to another, it would be unreaſonable to ſcreen an offender from the puniſhment due to natural crimes, by the refinements and ſubordinations of civil ſociety. In treaſon alſo (the higheſt crime which a member of ſociety can, as ſuch, be guilty of), no plea in coverture ſhall excuſe the wife; no preſumption of the huſband's coercion ſhall extenuate her guilt: as well becauſe of the odiouſneſs and dangerous conſequence of the crime itſelf, as becauſe the huſband, having broken through the moſt ſacred tie of ſocial community by rebellion againſt the ſtate, has no right to that obedience from a wife, which he himſelf as a ſubject has forgotten to pay. In inferior miſdemeanors alſo, we may remark another exception, that a wife may be indicted and ſet in the pillory with her huſband, for keeping a brothel: for this is an offence touching the domeſtic œconomy or government of the houſe, in which the wife has a principal ſhare; and is alſo ſuch an offence as the law preſumes to be generally conducted by the intrigues of the female ſex. And in all caſes where the wife offends alone, without the company or coercion of her huſband, ſhe is reſponſible for her offence as much as any feme-ſole.

2. Another ſpecies of compulſion or neceſſity is what our law calls *dureſs per minas;* or threats and menaces, which induce a fear of death or other bodily harm, and which take away for that reaſon the guilt of many crimes and miſdemeanors, at leaſt before the human tribunal. But then that fear which compels a man to do an unwarrantable action ought to be juſt and well-grounded; ſuch, "*qui cadere poſſit in virum conſtantem, non timidum et meticuloſum,*" as Bracton expreſſes it, in the words of the civil law Therefore, in time of war or rebellion, a man may be juſtified in doing many treaſonable acts by compulſion of the enemy or rebels, which would admit of no excuſe in the time of peace. This, however, ſeems only, or at leaſt principally, to hold as to poſitive crimes, ſo created by the laws of ſociety, and which therefore ſociety may excuſe; but not as to natural offences, ſo declared by the law of God, wherein human magiſtrates are only the executioners of divine puniſhment. And therefore though a man be violently aſſaulted, and hath no other poſſible means of eſcaping death but by killing an innocent perſon, this fear and force ſhall not acquit him of murder; for he ought rather to die himſelf than eſcape by the murder of an innocent. But in ſuch a caſe he is permitted to kill the aſſailant; for there the law of nature, and ſelf-defence its primary canon, have made him his own protector. Neceſſity.

3. There is a third ſpecies of neceſſity, which may be diſtinguiſhed from the actual compulſion of external force or fear; being the reſult of reaſon and reflection, which act upon and conſtrain a man's will, and oblige him to do an action which without ſuch obligation would be criminal. And that is, when a man has his choice of two evils ſet before him, and, being under a neceſſity of chooſing one, he chooſes the leaſt pernicious of the two. Here the will cannot be ſaid freely to exert itſelf, being rather paſſive than active; or, if active, it is rather in rejecting the greater evil than in chooſing the leſs. Of this ſort is that neceſſity, where a man by the commandment of the law is bound to arreſt another for any capital offence, or to diſperſe a riot, and reſiſtance is made to his authority: it is here juſtifiable, and even neceſſary, to beat, to wound, or perhaps to kill, the offenders, rather than permit the murderer to eſcape, or the riot to continue. For the preſervation of the peace of the kingdom, and the apprehending of notorious malefactors, are of the utmoſt conſequence to the public; and therefore excuſe the felony, which the killing would otherwiſe amount to.

4. There is yet another caſe of neceſſity, which has occaſioned great ſpeculation among the writers upon general law; viz. whether a man in extreme want of food or clothing may juſtify ſtealing either, to relieve his preſent neceſſities. And this both Grotius and Puffendorf, together with many other of the foreign juriſts, hold in the affirmative; maintaining by many ingenious, humane and plauſible reaſons, that in ſuch caſes the community of goods, by a kind of tacit conceſſion of ſociety, is revived. And ſome even of our lawyers have held the ſame; though it ſeems to be an unwarranted doctrine, borrowed from the notions of ſome civilians; at leaſt it is now antiquated, the law of England admitting no ſuch excuſe at preſent. And this its doctrine is agreeable not only to the ſentiments of many of the wiſeſt ancients, particularly Cicero, who holds, That *ſuum cuique incommodum ferendum eſt, potius quam de alterius commodis detrahendum;* but alſo to the Jewiſh law, as certified by King Solomon himſelf: "If a thief ſteal to ſatisfy his ſoul when he is hungry, he ſhall reſtore ſevenfold, and ſhall give all the ſubſtance of his houſe:" which was the ordinary puniſhment for theft in that kingdom. And this is founded upon the higheſt reaſon: for mens properties would be under a ſtrange inſecurity, if liable to be invaded according to the wants of others; of which wants no man can poſſibly be an adequate judge, but the party himſelf who pleads them. In England Neceſſity.

Necho.

especially, there would be a peculiar impropriety in admitting so dubious an excuse: for by the laws such sufficient provision is made for the poor by the power of the civil magistrate, that it is impossible that the most needy stranger should ever be reduced to the necessity of thieving to support nature. The case of a stranger is, by the way, the strongest instance put to Baron Puffendorf, and whereon he builds his principal arguments: which, however they may hold upon the continent, where the parsimonious industry of the natives orders every one to work or starve, yet must lose all their weight and efficacy in England, where charity is reduced to a system, and interwoven in our very constitution. Therefore our laws ought by no means to be taxed with being unmerciful, for denying this privilege to the necessitous; especially when we consider, that the king, on the representation of his ministers of justice, hath a power to soften the law, and to extend mercy in cases of peculiar hardship. An advantage which is wanting in many states, particularly those which are democratical: and these have in its stead introduced and adopted, in the body of the law itself, a multitude of circumstances tending to alleviate its rigour. But the founders of our constitution thought it better to vest in the crown the power of pardoning particular objects of compassion, than to countenance and establish theft by one general undistinguishing law.

NECHO, king of Egypt, began his reign 690 B. C. and was killed eight years after by Sabacon king of Ethiopia. Psammiticus his son succeeded him, and was the father, as Herodotus informs us, of Necho II. who reigned in the 616 B. C. This Necho II. is celebrated in history for attempting, though in vain, to cut a canal from the Nile to the Arabian gulf. He carried his arms as far as the Euphrates, and conquered the city of Carchemish. This prince is not only known in scripture under the name of *Necho*, but also in profane history. He no sooner succeeded to the crown than he raised great land armies, and fitted out vast fleets, as well upon the Mediterranean as upon the Red Sea: he gave battle to the Syrians near the city of Migdol; routed them, and made himself master of the city of Cadytis. The learned, however, are not agreed about this city Cadytis. Some will have it to be Cades in Arabia Petræa, others Jerusalem; and others say it is the city of Cedes, or Kedesh, in Galilee, in the tribe of Naphtali.

The scriptures acquaint us with the whole expedition of Necho in all its particulars. 2 Kings xxiii. 29. &c. and 2 Chr. xxxv. 20, 21, &c. In the year of the world 3394, this prince having drawn out his army into the field to make war with the Assyrians or Babylonians, and to take the city of Carchemish, otherwise called *Circusium*, upon the Euphrates, Josiah king of Judah, who was a tributary to the king of Babylon, marched to oppose his passage. Necho, who had no designs against him, sent to tell him, What have I to do with you, king of Judah? It is not against you that I am come forth, but against another people, against whom the Lord has commanded me to make war. Leave off therefore to set yourself against me, for fear the Lord should punish you for your resistance. But Josiah would not hearken to the remonstrances of Necho, but gave him battle at Megiddo, where he received the wound of which he died. The people of Jerusalem set up Jehoahaz for king of Judah, and Necho soon passed forwards, without making any longer stay in Judea.

Neck ‖ Necromancy.

But at his return from his expedition, which was very successful, he halted at Riblah in Syria; and sending for Jehoahaz king of the Jews, he deposed him, loaded him with chains, and sent him into Egypt. Then coming to Jerusalem, he set up Eliakim, or Jehoiakim, in his place, and exacted the payment of 100 talents of silver and one talent of gold from the country. Jeremiah (xlvi. 2.) acquaints us, that the city of Carchemish was taken from Necho by Nebuchadnezzar king of Babylon, in the fourth year of Jehoiakim king of Judah; so that Necho did not enjoy his conquest above four years. Josephus adds, that the king of Babylon pursuing his victory, brought under his dominion all the country which is between the Euphrates and Egypt, excepting Judea. Thus Necho was again reduced within the limits of his own country.

NECK, in anatomy, is the slender part situated between the head and trunk of the body. See ANATOMY, n° 31.

NECOPHORON, in botany, a name used by Pliny and other authors for the *smilax aspera*, or *rough bindweed*.

NECROLIUM, a word used by some of the alchemical writers to express a remedy almost always capable of averting death, and continuing life to its utmost period.

NECROLOGY, *necrologium*, formed of νεκρος, "dead," and λογος, "discourse or enumeration," a book anciently kept in churches and monasteries, wherein were registered the benefactors of the same, the time of their deaths, and the days of their commemoration; as also the deaths of the priors, abbots, religious, canons, &c. This was otherwise called *calendar* and *obituary*.

NECROMANCY, the art of revealing future events by a pretended communication with the dead.

This superstitious and impious imposture appears to have had its origin at a very early period in Egypt, and to have been thence propagated in every nation with the manners of which history has made us acquainted. The conquests of Sesostris might introduce it into India; the Israelites would naturally borrow it from the people among whom they sojourned 400 years; and it would easily find its way into Phœnicia, from the vicinity of that country to the land of its nativity. From the Egyptians and Phœnicians it was adopted, with the other rites of paganism, by the Greeks; and it was imported into Rome with Grecian literature and Grecian manners. It was not however confined to the pagan nations of antiquity; it spread itself through all the modern nations of Europe, and took such deep root as to be long retained even after those nations were converted to the Christian faith.

Of its early antiquity we have complete evidence in the writings of Moses, where it is severely condemned as an abomination to the Lord*; and though it appears to have been even then spread into Phenicia, we might yet conclude its birth-place to have been Egypt, because, at their *exody*, the Israelites were

* Deut. xviii. 10, 11, 12.

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corrupted only by Egyptian ſuperſtitions, and becauſe necromancy ſeems to be one of thoſe whoredoms which the prophet Ezekiel repreſents his countrymen as having brought with them from Egypt, and continued to practiſe till they were carried captives into Babylon.

If from ſacred we proceed to conſult profane authors, we ſhall find them not only affirming Egypt to have been the birth-place of necromancy, but in ſome degree accounting for the origin of ſo impious a deluſion. From Diodorus the Sicilian † we learn, that the Grecian fable of *Charon* the ferry-man of hell, of *Styx*, *Cocytus*, the *Elyſian Fields*, *Tartarus*, the judgement of *Minos*, and *Radamanthus*, &c. with the whole ſcenery of the infernal regions, were imported from Egypt into Greece. The ancient Egyptians, and indeed all the people of the eaſt, made uſe of caves for burying places, which were well ſuited to the ſolemn ſadneſs of the ſurviving friends, and proper receptacles for thoſe who were never more to behold the light. In Egypt, many of thoſe ſubterraneous cavities being dug out of the natural rock, ſtill remain and command the admiration of travellers; and near to the pyramids in particular there are ſome apartments of a wonderful fabric, which though they extend in length 4400 feet, and are about 30 feet in depth, appear to have been, if not entirely dug, at leaſt reduced to form by the chizzel or pick-axe of the artiſt.

† Lib. 1. § 2.

From the practice of burying in ſuch caverns ſprung the opinion that the infernal manſions were ſituated ſomewhere near the centre of the earth, which by the Egyptians was believed to be not very diſtant from its ſurface ‡. In theſe dreary manſions, it was very eaſy for ſuch adepts as the prieſts of Egypt to fabricate Erebus, Tartarus, the Elyſian Fields, and all thoſe ſcenes which were diſplayed before the initiated (ſee MYSTERIES), and by them deſcribed to the million of the people. As it was in thoſe dark abodes that necromancy was practiſed, it would be no difficult matter for ſuch magicians as withſtood Moſes to impoſe ſo far upon the credulous vulgar, as to make them believe, that in conſequence of their avocations they actually ſaw the ghoſts of their friends aſcend out of the earth. It appears from the book of Exodus, that the Iſraelitiſh women were, even in the wilderneſs, well acquainted with the uſe of the mirror, which was therefore undoubtedly known to the Egyptians. But a mirror of a particular form and properly illuminated at the inſtant required, might eaſily be made to reflect, in a cavern from which all other light was carefully excluded, the image of the deceaſed, who was called upon by the

‡ *Bryant's Analyſis of Mythology.*

necromancer; and we can readily conceive, that with reſpect to the queſtion to be propoſed, a perſon might be concealed, prepared to give ſuch ambiguous anſwers as would ſatisfy the inquirer, and at the ſame time ſave the credit of the oracle. The terrified imaginations of the ſpectators would aid the deluſion, and make a very ſlight reſemblance paſs for the ghoſt or εἴδωλον of their departed friend; or the necromancer might aſſign plauſible reaſons why a ſpectre, after having dwelt for ſome time in the infernal regions, ſhould loſe ſomething of its reſemblance to the body which it animated. Such juggling tricks, though performed by artiſts leſs accompliſhed than Jannes and Jambres, have gained credit among people much more enlightened than the Egyptians can poſſibly have been when the ſcience of necromancy was invented by their prieſts.

That the Iſraelites, notwithſtanding the prohibition of their legiſlator, continued to practiſe the rites of necromancy, is apparent from Saul's tranſaction with the witch of Endor (ſee MAGIC). From the ſame tranſaction, it is likewiſe apparent that the witches of Iſrael, and therefore in all probability the necromancers of Egypt, pretended to evocate the ghoſts of the dead by a *dæmon* or *familiar ſpirit*, which they had at their command to employ upon every emergency. This dæmon was called OB; and therefore Saul deſires his ſervants to find him a woman who was miſtreſs of an OB (A). It is probable that thoſe wretched impoſtors had in their pay ſome perſons who occaſionally acted the part of the dæmon, and when the execution of the plot required their agency, emitted, by means of a cavity dug for that purpoſe, a low hollow voice from below the ground. Hence we find Iſaiah, in his denunciations againſt Ariel*, ſaying, "Thou ſhalt be brought down, and ſhalt ſpeak out of the ground; and thy ſpeech ſhall be low out of the duſt, and thy voice ſhall be as one that hath a familiar ſpirit (an OB) out of the ground, and thy ſpeech ſhall whiſper out of the duſt."

* Chap. xxix. 4.

But though the Egyptian prieſts were undoubtedly the inventors of the whole myſtery of necromancy, and though it was from them imported into Greece by the SELLI or prieſts of Dodona, it does not appear that the Grecian necromancers pretended to be maſters of OBS or familiar ſpirits. Mopſus, Orpheus, Linus, Eumolpus, &c. who either travelled into Egypt in queſt of knowledge, or were actually natives of that country, inſtructed the early Greeks in this occult ſcience: but whatever might be the practice of theſe apoſtles themſelves, their diſciples profeſſed to do all

(A) The orginal, or radical, ſignification of this word occurs in Job xxxii. ver. 19; where Elihu compares his belly to new bottles, which he calls *oboth*, the plural of *ob*. But as bottles were then made of leather, new bottles filled with wine and ready to burſt, as Elihu deſcribes them, would of courſe be of a form nearly globular. Hence it may be inferred that the original import of *ob* was *round* or *globular*: but *b* and *p* being labials, are often changed into each other; and therefore from the Hebrew *ob* is derived the Greek ὀφ *oculus*, ὀπτομαι *video*, and the Latin *ops*, a name under which the earth was worſhipped. *Upis* was a name of Diana or the moon: the father of one of the Dianas was likewiſe *upis*; but this *upis* was undoubtedly the ſun. Now the difference between *upis* and *opis* is nothing; hence we are led to believe that as they are all derived from *ob*, this word was employed by the early idolaters of Egypt to denote the firſt and greateſt of Pagan gods, the ſun. If ſo, thoſe wretches who pretended to be miſtreſſes of *obs*, were exactly the ſame kind of impoſtors with the Pythoneſſes of the Greeks.

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all the feats of magic by performing certain rites, by offering certain ſacrifices, by muttering a certain form of words, by charms, ſpells, and exorciſms. By theſe they pretended to evocate the dead as certainly as the Egyptians and Jews did by their *familiar ſpirits*. By a ſmall diſplay of critical learning this might be eaſily proved from the popular ſtory of Orpheus and Euridice, which certainly was founded on one of theſe necromantic deceptions exhibited in a cave near Dodona, where the prieſts had a *hades* or infernal manſion, in humble imitation of thoſe with which the firſt of them were well acquainted in Egypt. It is indeed evident, without the aid of criticiſm: no man of any letters is ignorant, that whatever ſuperſtitions of this kind prevailed among the Romans were borrowed from the Greeks. But we all know that Virgil makes one of his ſhepherds, by means of certain herbs, poiſons, and ſenſeleſs charms, raiſe up ghoſts from the bottoms of their graves; and Lucan has fabricated a ſtory of this kind, which may be conſidered as an exact parallel to the witch of Endor. Juſt before the battle of Pharſalia he makes † young Pompey travel by night to a Theſſalian ſorcereſs, and anxiouſly inquire of her the iſſue of the war. This female necromancer, by a tedious proceſs of charms and incantations, conjures up the ghoſt of a ſoldier who had been lately ſlain. The phantom, after a long preamble, denounces a prediction much of the ſame kind with that which the king of Iſrael received from Samuel at Endor; and though we have elſewhere ſhown, that nothing but the ſpirit of God could have foreſeen the inevitable deſtruction of Saul, his ſons, and his army (ſee MAGIC), it was very eaſy for any man of tolerable ſagacity to foreſee the defeat of Pompey's raw and undiſciplined troops by the hardy veterans of the victorious Cæſar.

† Lib. vi. ver. 570. *et ſeq.*

It would be endleſs to enumerate all the fallacious evocations of ghoſts, and the ambiguous reſponſes returned by thoſe pretended ſpirits, of which we have accounts from the poets and hiſtorians of the celebrated nations of antiquity. We ſhall therefore proceed to mention a few which occur in the fabulous hiſtory of more modern nations, and then leave the ſubject to the meditation of our readers. In Mallet's northern antiquities, we have the following account of a necromantic exploit, between which, and the deſcent of the ancient heroes into hell, it is impoſſible not to remark a ſtriking ſimilitude.

"Odin the ſovereign of man ariſes. He ſaddles his horſe Sleipner; he mounts, and is conveyed to the ſubterraneous abode of *Hela*. The dog which guards the gates of death meets him. His breaſt and his jaws are ſtained with blood. He opens his voracious mouth to bite, and barks a long time at the father of magic. Odin purſues his way; and the infernal cavern reſounds and trembles under his horſe's hoofs. At length he reaches the deep abode of death, and ſtops near the eaſtern gate, where ſtands the tomb of the propheteſs. He ſings with a voice adapted to call up the dead; he looks towards the world; he engraves Runic characters on her tomb; he utters myſterious words; and he demands an anſwer, until the propheteſs is conſtrained to ariſe and thus utter the words of the dead.—"Who is this unknown that dares to diſturb my repoſe, and drag me from the grave, in which I have been dead ſo long, all covered with ſnow, and moiſtened with the rains?" &c.

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The Gallic druids pretended to be maſters of the ſame ſecret. This is evident from the name of a ſpecies of divination, not uncommon among the Scotch Highlanders ſo lately as in the beginning of the preſent century. By a gentleman excellently verſed in the antiquities of that people, and a ſteady friend to the writer of this article, we have been informed, that not many years ago ſome of the Highlanders relied implicitly upon certain oracular reſponſes, called in their language *taghairm*. This word ſeems to be compounded of *ta*, which in ſome parts of the Highlands is ſtill uſed to denote a ſpirit or ghoſt, and *ghairm*, which ſignifies *calling upon* or invoking. *Taghairm*, therefore, in its original import, is *necromancy* in the moſt proper ſenſe of that word.

There were different kinds of *taghairm*, of which one was very lately practiſed in *Sky*. The diviner covered himſelf with a cow's hide, and repaired at night to ſome deep-ſounding cave, whither the perſon who conſulted him followed ſoon after without any attendants. At the mouth of the cave he propoſed aloud the queſtions of which he wanted ſolutions; and the man within pronounced the reſponſes in a tone of voice ſimilar to that with which the OBS, or pretended dæmons of antiquity, gave from beneath the ground their oracular anſwers. That in the latter days of *taghairm*, the Gallic diviners pretended to evocate ghoſts, and from them to extort ſolutions of difficulties propoſed, we have no poſitive evidence; but that ſuch was the original pretence, there can be little doubt, when we reflect either upon the place where this ſpecies of divination was practiſed, or upon the import of the word by which it was denominated.

As we have been led to mention *taghairm*, we ſhall beg leave to make a few obſervations on another ſpecies of it, called *taghairm an uiſge*, or "*taghairm* by water." This too was laſt practiſed in the Iſle of Sky, by a man of the name of *M'Cuidhean*, whoſe anceſtors had long been famous for the art. He lived near a beautiful caſcade on a ſmall river; and when conſulted on any matter of conſequence, he covered his whole body with a cow's hide, that neceſſary implement of Highland divination, and placed himſelf between the water of the caſcade and the rock over which it flowed. Then another man with a heavy pole gave repeated ſtrokes to the water, and the diviner behind it crying out now and then in Gaelic, "Is this a ſtock of arn?" This operation was continued till M'Cuidhean was perceived to be frantic or furious, when he was conſidered as in a condition to anſwer the moſt important queſtions. He was frequently conſulted about futurity; and though he could not, in the proper ſenſe of the word, be called a *necromancer*, his reſponſes were liſtened to as proceeding from ſomething more than human. A degree of frenzy, either real or affected, ſeems to have accompanied the predictions of certain kinds of diviners in all ages; and we cannot help remarking the ſimilarity between the madneſs of M'Cuidhean and that of the Sybil in the fixth book of the Æneid; though we

Necropolis || Nectarium.

cannot ſuppoſe the one to have been borrowed from the other.

At, Phœbi nondum patiens, immanis in antro
Bacchatur vates, magnum ſi pectore poſſit
Excuſiſſe Deum: tanto magis ille fatigat
Os rabidum, fera corda domans, fingitque premendo.

Struggling in vain, impatient of her load,
And lab'ring underneath the pond'rous god;
The more ſhe ſtrove to ſhake him from her breaſt,
With more and far ſuperior force he preſs'd.
Dryden.

That all theſe pretences, whether ancient or modern, to the power of divination by means of familiar ſpirits, or by the art of necromancy, were groundleſs as well as impious, it would be affronting the underſtandings of our readers to offer any proof. Under the article MAGIC we have ſaid enough on the ſubject, and perhaps more than enough, to thoſe who know that dæmons, if they have any exiſtence, and the departed ſpirits of good and bad men, are all under the controul of Him who governs the intellectual as well as material world by fixed and equal laws.—Theſe details of ſuperſtition, however, will not be uſeleſs, if, by ſhowing how poor and wretched a creature man becomes when left to his own inventions, they ſhall make any one grateful for the benefits of good government, and the bleſſings of revealed religion.

NECROPOLIS, a ſuburb of Alexandria in Egypt. It ſignifies "the City of the Dead;" wherein there were temples, gardens, and ſuperb mauſoleums. Here Cleopatra is ſaid to have applied the aſpic to her breaſt, to prevent being led in triumph by Auguſtus, who endeavoured to ſave her.

NECROSIS, νεκρωσις, in medicine, a complete mortification of any part; called alſo *ſideratio* and *ſphacelus*.

NECTANEBUS, or NECTANABIS, a king of Egypt, who defended his country againſt the Perſians. His grandſon of the ſame name made an alliance with Ageſilaus king of Sparta, and with his aſſiſtance he quelled a rebellion of his ſubjects. Sometime after he was joined by the Sidonians, Phœnicians, and inhabitants of Cyprus, who had revolted from the king of Perſia. This powerful confederacy was ſoon attacked by Darius the king of Perſia, who marched at the head of his troops. Nectanebus, to defend his frontiers againſt ſo dangerous an enemy, levied 20,000 mercenary ſoldiers in Greece, the ſame number in Libya, and 60,000 were furniſhed in Egypt. This numerous body was not equal to the Perſian forces, and Nectanebus, defeated in a battle, gave up all hopes of reſiſtance, and fled into Ethiopia, where he found a ſafe aſylum. His kingdom of Egypt became from that time tributary to the king of Perſia.

NECTAR, among ancient poets, the drink of the fabulous deities of the heathens; in contradiſtinction from their ſolid food, which was called *ambroſia*.

NECTARINE, a fruit differing in nothing from the common peach, of which it is a ſpecies, than in having a ſmoother rind and a firmer pulp. See PERSICA.

NECTARIUM, from *nectar*, the fabled "drink of the gods;" defined by Linnæus to be a part of the corolla, or appendage to the petals, appropriated for containing the honey, a ſpecies of vegetable ſalt under a fluid form, that oozes from the plant, and is the principal food of bees and other inſects. Nectarium.

Notwithſtanding this definition, which ſeems to conſider the nectarium as neceſſary a part of the corolla as the petals; it is certain that all flowers are not provided with this appendage, neither indeed is it eſſential to fructification.

There is, beſides, a manifeſt impropriety in terming the nectarium a part of the corolla Linnæus might, with equal propriety, have termed it a part or appendage of the ſtamina, calyx, or pointal, as the appearance in queſtion is confined to no particular part of the flower, but is as various in point of ſituation as of form. The truth is, the term *nectarium* is exceedingly vague; and, if any determinate meaning can be affixed to it, is expreſſive of all the ſingularities which are obſerved in the different parts of flowers. *Milne's Bot. Dict.*

The tube, or lower part of flowers with one petal, Linnæus conſiders as a true nectarium, becauſe it is generally found to contain the ſweet liquor formerly mentioned. This liquor Pontedera compares to that called *amnios* in pregnant animals, which enters the fertile or impregnated ſeeds: but that this is not at leaſt its ſole uſe, is evident from this circumſtance, that the honey or liquor in queſtion is to be found in flowers where there are either no ſeeds, or thoſe which, from the want of male organs, cannot be impregnated. Thus the male flowers of nettle and willow, the female flowers of ſea-ſide laurel and black bryony, the male and female flowers of clutia, higgelaria, and butcher's broom, all abound with the honey or nectar alluded to.

Dr Vaillant was of opinion, that the nectarium was an eſſential part of the corolla; for which reaſon he diſtinguiſhed the ſingular appearances in fennel-flower and columbine by the name of *petals*: the coloured leaves which are now termed the *petals* he denominates the *flower cup*.

That the nectarium, however, is frequently diſtinct from the petals, is evident both from the well-known examples juſt mentioned, as likewiſe from the flowers of monkſhood, hellebore, iſopyrum, fennel-flower of Crete, barrenwort, graſs of Parnaſſus, chocolate-nut, cherleria, and ſauvageſia.

Theſe general obſervations being premiſed, we proceed to take a nearer and more particular view of the principal diverſities, both in form and ſituation, of this ſtriking appendage to the flower. 1. In many flowers the nectarium is ſhaped like a ſpur or horn; and that either in flowers of one petal, as valerian, water-milfoil (*urticularia*), butter-wort, and calves-ſnout; or in ſuch as have more than one, as lark-ſpur, violet, fumatory, balſam, and orchis. 2. In the following plants, the nectarium is properly a part of the corolla, as lying within the ſubſtance of the petals: ranunculus, lily, iris, crown-imperial, water-leaf, mouſe-tail, ananas or pine-apple, dog's-tooth violet, piperidge buſh, valliſneria, hermannia, uvularia, and ſwertia. 3. The nectarium is frequently placed in a ſeries or row within the petals, though entirely unconnected with their ſubſtance. In this ſituation it often reſembles a cup, as in narciſſus. A nectarium of this kind is ſaid by Linnæus to crown the corolla. The following are examples: daffodil, ſea-daffodil, campion, viſcous campion,

Nectarium
||
Necydalis.

pion, ſwallow-wort, ſtapelia, cynanchum, nepenthes, cherleria, balſam-tree, African ſpiræa, witch-hazel-olax, and paſſion-flower. 4. In Indian creſs, buckler, muſtard, Barbadoes cherry, and monotropa, the nectarium is ſituated upon or makes part of the calyx. 5. The nectarium in baſtard flower-fence is ſeated upon the antheræ or tops of the ſtamina; whence the name *adenanthera*, or *glandular anthera*, which has been given to this genus of plants. In the following liſt it is placed upon the filaments; bean-caper, bay, fraxinella, marvel of Peru, bell-flower, lead-wort, roëlla, and commelina. 6. In hyacinth, flowering-ruſh, ſtock July-flower, and rocket, the nectarium is placed upon the ſeed-bud. 7. In honey-flower, orpine, buck-wheat, collinſonia, lathræa, navel-wort, mercury, clutia, kiggelaria, ſea-ſide laurel, and African ſpiræa, it is attached to the common receptacle. Laſtly, in ginger, nettle, dyer's weed, heart-ſeed, coſtus, turmeric, grewia, baſtard-orpine, vanelloe, ſkrew-tree, and willow, the nectarium is of a very ſingular conſtruction, and cannot properly fall under any of the foregoing heads.

In diſcriminating the genera, the nectarium often furniſhes an eſſential character.

Plants which have the nectarium diſtinct from the petals, that is, not lodged within their ſubſtance, are affirmed by Linnæus to be generally poiſonous. The following are adduced as examples: monk's hood, hellebore, columbine, fennel-flower, graſs of Parnaſſus, barren-wort, oleander, marvel of Peru, bean-caper, ſucculent ſwallow-wort, fraxinella, and honey-flower.

NECUIA, in botany, a name given by the ancient Greeks to a ſpecies of mullein.

The Greeks and Romans both uſed the ſtalks of a peculiar kind of mullein, called *thryallis* by Nicander. For the making of wicks of lamps we have a kind of mullein called *lychnites*, and candle-wick mullein, from the λυχνίτις of Dioſcorides; but it is not certain that ours is the ſame plant.

The ancients uſed the ſtalks of many different plants for the wicks of their candles and lamps. The ruſh, ſtripped of its bark, was as commonly in uſe with them as with us for this purpoſe; and they alſo uſed the nettle, this mullein, and many other plants, whoſe ſtalks were compoſed of tough filaments, for the ſame purpoſe; beating them out like hemp, and when dry dipping them in melted reſin, and other ſuch inflammable ſubſtances. When thus prepared, they are readily inflammable, like our flambeau; and this mullein, having ſtalks more long and large, and more firm than all the others, was uſed to make thoſe lights with which they ſet fire to the funeral pile, for conſuming the aſhes of their dead friends.

NECYDALIS, in zoology, a genus of inſects belonging to the order of coleoptera. The feelers are ſetaceous; the elytra are ſhorter and narrower than the wings; the tail is ſimple. There are 11 ſpecies, chiefly diſtinguiſhed by the ſize and figure of their elytra. Barbut ſays, "Its head is black, eyes are large and prominent, jaws are of a dark brown. The antennæ placed on the top of the head between the eyes have their firſt articulation long and raiſed upright, the reſt bent and turned aſide. The antennæ vary as to length and colour. In individuals whoſe thorax is yellow, they are brown, and equal only to two-thirds of the body in length. On the contrary, in thoſe whoſe thorax is black, they are likewiſe black, and ſomewhat longer than the body. The thorax is margined; in ſome it is yellow and longer; in others it is black, ſhorter, and edged only with a little yellow. The elytra are blackiſh, ſomewhat clearer in the middle, and terminating in a lemon coloured ſpot. The wings are rather black, ſomething longer than the body, exceed the elytra by one-third, and are croſſed one over the other. In thoſe that have their thorax yellow, the legs and under part of the belly are ſo likewiſe. In individuals with a black thorax, the legs are black as well as the belly, which has only a little yellow on the ſides. I ſuſpect the latter to be the males. The larva is as yet unknown."

Nedham.

NEDHAM (Marchmont), an Engliſh ſatyrical writer, was born at Burford Oxon. about the month of Auguſt 1620. His father died in 1621; but the following year his mother was again married to one Chriſtopher Glynn, vicar and ſchoolmaſter of Burford; who perceiving his ſon-in-law's pregnancy of parts and genius, took him under his own tuition, and at the age of 14 ſent him to All Souls College, Oxon. Here he was made one of the choriſters, and continued till 1637, when, having taken the degree of A. B. which made it inconſiſtent to continue in that office, he went to St Mary's Hall till he became an uſher in Merchant Taylor's ſchool, London. About the beginning of the civil wars, he became clerk to an attorney at Gray's Inn, where, writing a good court hand, he obtained a decent ſubſiſtence. Not long after this, he began a weekly paper, under the title of *Mercurius Britannicus*, on the ſide of the parliament: it commenced about the middle of Auguſt 1643, coming out on Mondays, in one ſheet, and continued till the end of 1646. It procured him popularity, and being an active man he was diſtinguiſhed by the title of Capt. Nedham of Gray's Inn. Of theſe mercuries (for there were a number of them publiſhed on both ſides of the great queſtion which then divided the nation), it is well obſerved by Johnſon, that they taught many to talk whom they could not teach to judge. Nedham's was, indeed, addreſſed as much to the paſſions as the reaſon; and, by telling every man that he was equal to his king, he ſo flattered vulgar pride, that his licentious opinions were received as the dictates of an oracle. About this time he ſtudied phyſic, and in 1645 began to practiſe; by which, and his political writings, he ſupported a genteel figure. But, for ſome ſcorn and affront put upon him, he ſuddenly left his party, and, obtaining the favour of a royaliſt, was introduced into the king's preſence at Hampton-court in 1647, and aſking pardon upon his knees readily obtained it; ſo that being admitted to the king's favour, he wrote ſoon after another paper, entitled *Mercurius Pragmaticus*; which being equally witty with the former, as ſatirical againſt the Preſbyterians, and full of loyalty, made him known and admired by the wits of that ſide. However, being narrowly ſought after, he left London, and for a time lay concealed at the houſe of Dr Peter Heylin, at Minſter-Lovel, near Burford, till at length being diſcovered, he was impriſoned in Newgate, and in danger of his life. Lenthal, the ſpeaker of the Houſe of Commons, who knew him and his

Nedham, Needham.

relations well, and Bradſhaw, preſident of the high-court of juſtice, treated him favourably, and not only got his pardon, but with promiſe of rewards and places perſuaded him to change his ſide once more for the independents, who then were the uppermoſt party.—In this temper he publiſhed a third weekly paper, called *Mercurius Politicus*, which came out every Wedneſday, in two ſheets 4to, commencing with the 9th of June 1649, and ending with the 6th of June 1650, which being Thurſday, he began again with number 1. from Thurſday June 6, to Thurſday June 13, 1650, beginning, "Why ſhould not the commonwealth have "a fool, as well as the king had, &c." This paper, which contained many diſcourſes againſt monarchy, and in behalf of a free ſtate, eſpecially thoſe that were publiſhed before Cromwell was made protector, was carried on without any interruption till about the middle of April 1660, when, as ſeveral times before, it was prohibited by an order of the council of ſtate.—Upon the return of Charles II. our author lay hid, till, by virtue of ſome money well placed, he obtained his pardon under the great ſeal; after which he exerciſed the faculty of phyſic among the Diſſenters, which brought him in a conſiderable benefit till his death, which happened ſuddenly in 1678. Wood, who knew him, tells us that he was a perſon endowed with quick natural parts, was a good humaniſt, poet, and boon droll; and, had he been conſtant to his cavaliering principles, would have been beloved and admired by all; but being mercenary, and preferring his intereſt to his conſcience, friendſhip, and love to his prince, was much hated by the royal party to the laſt. In ſhort, there was no depending on this ſcurrilous ill-natured author. He followed whenever intereſt or paſſion led, and remains a notorious inſtance of the danger of brilliant parts, of which he certainly was poſſeſſed, without judgment or integrity to controul them. Wood, who in his Athen. Oxon. quoted above, gives a very copious account of him, ſays: "At length this moſt ſeditious, mutable, and railing "author, M. Nedham, died ſuddenly, in the houſe "of one Kidder, in D'Eureux-court near Temple-"bar, London, in 1678, and was buried near the "entrance of the chancel of the church of St Cle-"ments Danes."

Athen. Oxon. vol ii.

NEEDHAM (John Tuberville), was born at London the 10th of September in the year 1713. His parents were deſcended from ancient and noble families. His father, who had once poſſeſſed a conſiderable patrimony at Hilſton, in the county of Monmouth, was of the younger and Catholic branch of the Needham family: the head of the elder and Proteſtant branch was lord Kilmory, created viſcount in the year 1625. The father of Mr Needham died young, and left but a ſmall fortune to his four children. His eldeſt ſon, who is the ſubject of this article, proſecuted his ſtudies under the ſecular clergy of the Engliſh college of Douai, where he took orders, taught rhetoric for ſeveral years, gave eminent proofs of ſagacity and genius, and ſurpaſſed all the other profeſſors of that ſeminary in the knowlegde of experimental philoſophy. In 1740, he was engaged by his ſuperiors in the ſervice of the Engliſh miſſion, and was entruſted with the direction of the ſchool erected at Twyford, near Wincheſter, for the education of the Roman Catholic youth. In 1744, he was appointed profeſſor of philoſophy in the Engliſh college at Liſbon, where, on account of his bad health, he remained only 15 months. After his return, he paſſed ſeveral years at London and Paris, which were principally employed in microſcopical obſervations, and in other branches of experimental philoſophy. The reſults of theſe obſervations and experiments were publiſhed in the Philoſophical Tranſactions of the Royal Society of London in 1749, and in a volume in 12mo at Paris in 1750; and an account of them was alſo given by M. de Buffon, in the firſt volumes of his Natural Hiſtory. There was an intimate connection between this illuſtrious French naturaliſt and Mr Needham: they made their experiments and obſervations togegether; though the reſults and ſyſtems which they deduced from the ſame objects and operations were totally different. Mr Needham was admitted to a place in the Royal Society of London in the year 1747, and in the Antiquarian Society ſome time after. From the year 1751 to 1767 he was chiefly employed in finiſhing the education of ſeveral Engliſh and Iriſh noblemen, by attending them as tutor in their travels through France, Italy, and other countries. He then retired from this wandering life to the Engliſh ſeminary at Paris, and in 1768 was choſen by the Royal Academy of Sciences in that city a correſponding member. Needham.

When the regency of the Auſtrian Netherlands, in order to the revival of philoſophy and literature in that country, formed the project of an Imperial academy, which was preceded by the erection of a ſmall literary ſociety to prepare the way for its execution, Mr Needham was invited to Bruſſels by Count Cobentzel and the preſident Neny, and was appointed ſucceſſively chief director of both theſe foundations. He held this place, together with ſome eccleſiaſtical preferments in the Low Countries, until his death, which happened the 30th of December 1781. "His piety, temperance, and purity of manners (we follow the expreſſions of the Abbé Mann) were eminent: his attachment to the doctrines and duties of Chriſtianity was inviolable. His zealous oppoſition to modern infidels was indefatigable and even paſſionate. His probity was untainted. He was incapable of every ſpecies of duplicity; his beneficence was univerſal, and his unſuſpicious candour rendered him often a dupe to perfidy." Theſe and other good qualities the panegyriſt attributes to his deceaſed friend; and the learned authors of the Monthly Review, to whom Mr Needham was known, admit the juſtneſs of the panegyric. He was undoubtedly (ſay they) both an honeſt man and a worthy citizen; but though his death be a real loſs to the literary world, yet he died ſeaſonably for himſelf; for had he lived to ſee Joſeph the IId. and the Great making ſo free with the paint, patches, and trinkets of the mother church, confiſcating her lands, aboliſhing her convents, ſuppreſſing her holidays, introducing common ſenſe into her worſhip, erecting political conductors to diſperſe the thunder of the Vatican, and atchieving many other things in this ſtyle of improvement, it would have vexed full ſore his feeling heart. For this honeſt man was narrow even to ſuperſtition and bigotry in his religious ſyſtem; and we never knew a man in whom there was ſuch an

Needham, Needle.

unaccountable mixture of implicit faith and philoſophical curioſity as in Mr Needham. He was a keen and judicious obſerver of nature, had a peculiar dexterity in confirming his obſervations by experiments, and he was always occupied (ſometimes indeed with too much fancy and precipitation) in generalizing facts, and reducing them to his ſyſtem. "His pen (ſays Abbé Mann) was neither remarkable for fecundity nor method: his writings are rather the great lines of a ſubject expreſſed with energy, and thrown upon paper in a hurry, than finiſhed treatiſes." His works are well known both in Britain and in France.

NEEDHAM, in Suffolk, 73 miles from London, ſtands on the Orwell, 9 miles from Ipſwich, in the road to Huntingdonſhire. Its market is on Wedneſday, and fair in October 28.

NEEDLE, a very common little inſtrument or utenſil made of ſteel, pointed at one end, and pierced at the other, uſed in ſewing, embroidery, tapeſtry, &c.

Needles make a very conſiderable article in commerce, though there is ſcarce any commodity cheaper, the conſumption of them being almoſt incredible.—The ſizes are from n° 1. the largeſt, to n° 25. the ſmalleſt. In the manufacture of needles, German and Hungarian ſteel are of moſt repute.

In the making of them, the firſt thing is to paſs the ſteel through a coal fire, and under a hammer, to bring it out of its ſquare figure into a cylindrical one. This done, it is drawn through a large hole of a wire-drawing iron, and returned into the fire, and drawn through a ſecond hole of the iron ſmaller than the firſt; and thus ſucceſſively from hole to hole, till it has acquired the degree of fineneſs required for that ſpecies of needles; obſerving every time it is to be drawn, that it be greaſed over with lard, to render it more manageable. The ſteel thus reduced to a fine wire, is cut in pieces of the length of the needles intended. Theſe pieces are flatted at one end on the anvil, in order to form the head and eye: they are then put into the fire, to ſoften them farther; and thence taken out and pierced at each extreme of the flat part on the anvil, by force of a puncheon of well-tempered ſteel, and laid on a leaden block to bring out, with another puncheon, the little piece of ſteel remaining in the eye. The corners are then filed off the ſquare of the heads, and a little cavity filed on each ſide of the flat of the head; this done, the point is formed with a file, and the whole filed over: they are then laid to heat red hot on a long narrow iron, crooked at one end, in a charcoal fire; and when taken out thence, are thrown into a baſon of cold water to harden. On this operation a good deal depends; too much heat burns them, and too little leaves them ſoft; the medium is learned by experience. When they are thus hardened, they are laid in an iron ſhovel on a fire more or leſs briſk in proportion to the thickneſs of the needles; taking care to move them from time to time. This ſerves to temper them, and take off their brittleneſs; great care here too muſt be taken of the degree of heat. They are then ſtraightened one after another with the hammer, the coldneſs of the water uſed in hardening them having twiſted the greateſt part of them.

The next proceſs is the poliſhing them. To do this, they take 12,000 or 15,000 needles, and range them in little heaps againſt each other on a piece of new buckram ſprinkled with emery-duſt. The needles thus diſpoſed, emery-duſt is thrown over them, which is again ſprinkled with oil of olives; at laſt the whole is made up into a roll, well bound at both ends. This roll is then laid on a poliſhing table, and over it a thick plank loaded with ſtones, which two men work backwards and forwards a day and a half, or two days, ſucceſſively; by which means the roll thus continually agitated by the weight and motion of the plank over it, the needles withinſide being rubbed againſt each other with oil and emery, are inſenſibly poliſhed. After poliſhing, they are taken out, and the filth waſhed off them with hot water and ſoap: they are then wiped in hot bran, a little moiſtened, placed with the needles in a round box, ſuſpended in the air by a cord, which is kept ſtirring till the bran and needles be dry. The needles thus wiped in two or three different brans, are taken out and put in wooden veſſels, to have the good ſeparated from thoſe whoſe points or eyes have been broken either in poliſhing or wiping; the points are then all turned the ſame way, and ſmoothed with an emery ſtone turned with a wheel. This operation finiſhes them, and there remains nothing but to make them into packets of 250 each. Needles were firſt made in England by a native of India in 1545, but the art was loſt at his death: it was, however, recovered by Chriſtopher Greening in 1560, who was ſettled with his three children, Elizabeth, John, and Thomas, by Mr Damar, anceſtor of the preſent lord Milton, at Long Crendon in Bucks, where the manufactory has been carried on from that time to this preſent day.

Needle.

Dipping-Needle, or *Inclinatory Needle*, a magnetical needle, ſo hung, as that, inſtead of playing horizontally, and pointing out north and ſouth, one end dips, or inclines to the horizon, and the other points to a certain degree of elevation above it. Plate CCCXLV. fig. 2.

The dipping-needle was invented in the year 1576 by one Robert Norman a compaſs maker at Wapping. The occaſion of the diſcovery, according to his own account, was, that it being his cuſtom to finiſh and hang the needles of his compaſſes before he touched them, he always found, that immediately after the touch, the north-point would bend or incline downward, under the horizon; inſomuch that, to balance the needle again, he was always forced to put a piece of wax on the ſouth end as a counterpoiſe. The conſtancy of this effect led him at length to obſerve the preciſe quantity of the dip, or to meaſure the greateſt angle which the needle would make with the horizon; and this at London he found to be 71° 50′. In 1723 Mr Graham made a great many obſervations on the dipping-needle, and found the angle to be between 74 and 75 degrees. Mr Nairne, in 1772, found it to be ſomewhat above 72°. It is not certain whether the dip varies, as well as the horizontal direction, in the ſame place. The trifling difference between Mr Forman and Mr Nairne would lead us to imagine that the dip was unalterable; but Mr Graham, who was a very accurate obſerver, makes the difference more conſiderable. It is certain, however, from a great number of experiments and obſervations, that the dip is variable in different latitudes, and that it increaſes in going northwards. It appears from a table of obſervations made with the marine dipping-needle in a

voyage

Needle. voyage towards the north pole in 1733, that in lat. 60. 18. the dip was 75°; and in lat. 70. 45. it was 77° 52′; in lat. 80. 12. it was 81° 52′; and in lat. 80. 27. it was 82° 2½′.

Several authors have endeavoured to apply this diſcovery of the dip to the finding of the latitude; and Mr Bond attempted to apply it to the finding of the longitude alſo; but for want of obſervations and experiments he could not make any progreſs. The affair was farther proſecuted by Mr Whiſton, who publiſhed a treatiſe on the longitude, and for ſome time imagined it was poſſible to find it exactly by means of the dip of the needle; yet he at laſt deſpaired of it, for the following reaſons. 1. The weakneſs of the magnetic power. 2. The concuſſion of the ſhip, which he found it exceeding difficult to avoid ſo much as was neceſſary for the accuracy of the experiments. 3. The principal objection was an irregularity in the motions of all magnetic needles, both horizontal and dipping, by which they, within the compaſs of about a degree, vary uncertainly backward and forward; even ſometimes, in a few hours time, without any evident cauſe. For a particular account of theſe variations both of the horizontal and dipping needle, ſee the article VARIATION.

Mr Nairne made a dipping-needle in 1772 for the board of longitude, which was uſed in the voyage towards the north-pole. This is repreſented Plate CCCXLV. fig. 2. The needle AA is 12 inches long, and its axis, the ends BB of which are made of gold alloyed with copper, reſts on friction-wheels CCCC, of four inches diameter, each end on two friction-wheels; which wheels are balanced with great care. The ends of the axes of the friction-wheels are likewiſe of gold alloyed with copper, and moved in ſmall holes made in bell-metal; and oppoſite to the ends of the axes of the needle and the friction-wheels, are flat agates, ſet in at DDD, finely poliſhed. The magnetic needle vibrates within a circle of bell-metal, EEE, divided into degrees and half degrees; and a line, paſſing through the middle of the needle to the ends, points to the diviſions. The needle of this inſtrument was balanced before it was made magnetical; but by means of a croſs, the ends of which are FFFF, (contrived by the reverend Mr Mitchell) fixed on the axis of the needle, on the arms of which are cut very fine ſcrews to receive ſmall buttons, that may be ſcrewed nearer or farther from the axis, the needle may be adjuſted both ways to a great nicety, after being made magnetical, by reverſing the poles, and changing the ſides of the needle. GG are two levels, by which the line of 0 degrees of the inſtrument is ſet horizontal, by means of the four adjuſting ſcrews LLLL; H is the perpendicular axis, by which the inſtrument may be turned, that the divided face of the circle may front the eaſt or weſt; to this axis is fixed an index I, which points to an oppoſite line on the horizontal plate K when the inſtrument is turned half round; MMMM are ſcrews which hold the glaſs-cover to keep the needle from being diſturbed by the wind. When this needle is conſtructed for ſea, it is ſuſpended by an univerſal joint on a triangular ſtand, and adjuſted vertically by a plumb-line and button above the divided circle and the dovetail work at the upper 90; and the diviſions on the circle are adjuſted ſo as to be perpendicular to the horizon by the ſame plumb-line, and an adjoining ſcrew; and when it is adjuſted, a pointer annexed to a ſcrew, which ſerves to move the divided circle, is fixed at the loweſt 90. Whenever the inſtrument is uſed to find the dip, it muſt be ſo placed that the needle may vibrate exactly in the magnetic meridian. Needle.

Magnetical NEEDLE, in navigation, a needle touched with a loadſtone, and ſuſtained on a pivot or centre; on which playing at liberty, it directs itſelf to certain points in or under the horizon; whence the magnetical needle is of two kinds, viz. horizontal or inclinatory. See the article MAGNET.

Horizontal needles are thoſe equally balanced on each ſide of the pivot that ſuſtains them; and which, playing horizontally with their two extremes, point out the north and ſouth points of the horizon. For their application and uſe, ſee the article COMPASS.

In the conſtruction of the horizontal needle, a piece of pure ſteel is provided; of a length not exceeding ſix inches, leſt its weight ſhould impede its volubility; very thin, to take its verticity the better; and not pierced with any holes, or the like, for ornament ſake, which prevent the equable diffuſion of the magnetic virtue. A perforation is then made in the middle of its length, and a braſs cap or head ſoldered on, whoſe inner cavity is conical, ſo as to play freely on a ſtyle or pivot headed with a fine ſteel point. The north point of the needle in our hemiſphere is made a little lighter than the ſouthern; the touch always deſtroying the balance, if well adjuſted before, and rendering the north end heavier than the ſouth, and thus occaſioning the needle to dip.

The method of giving the needle its verticity or directive faculty has been ſhown already under the article MAGNET; but if, after touching, the needle be out of its equilibrium, ſomething muſt be filed off from the heavier ſide, till it balance evenly.

Needles in ſea-compaſſes are uſually made of a rhomboidal or oblong form: we have given their ſtructure already under the article COMPASS.

The needle is not found to point preciſely to the north, except in very few places; but deviates from it more or leſs in different places, and that too at different times; which deviation is called its *declination* or *variation from the meridian*. See the article VARIATION.

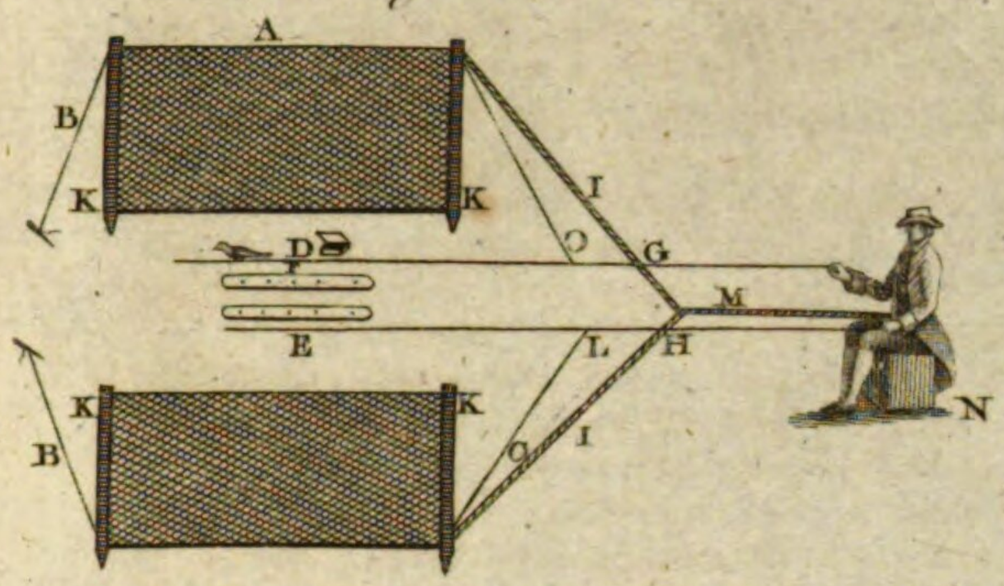
Surgeons NEEDLES are generally made crooked, and their points triangular: however they are of different forms and ſizes, and bear different names, according to the purpoſes they are uſed for.

The largeſt are needles for amputation; the next, needles for wounds; the fineſt needles for ſutures. They have others, very ſhort and flat, for tendons; others, ſtill ſhorter, and the eye placed in the middle, for tying together of veſſels, &c. Needles for couching cataracts are of various kinds; all of which have a ſmall, broad, and ſharp point or tongue; and ſome with a ſulcus at the point. Surgeons have ſometimes uſed two needles in this operation; one with a ſharp point for perforating the coats of the eye, and another with a more obtuſe point for depreſſing or couching the opaque cryſtalline lens: but care ſhould be taken in the uſe of any of theſe, that they be firſt well poliſhed with cloth or leather, before they are applied to the eye.

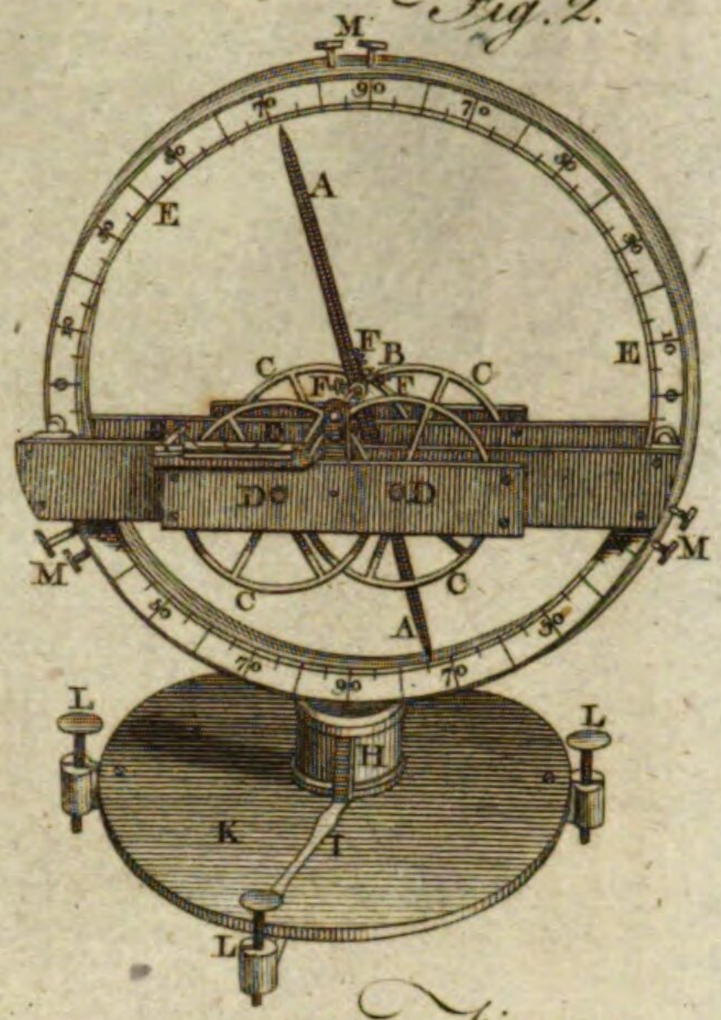
Mr Warner obſerves, that the blade of the couching needle

Plate CCCXLV.

Day Nett.

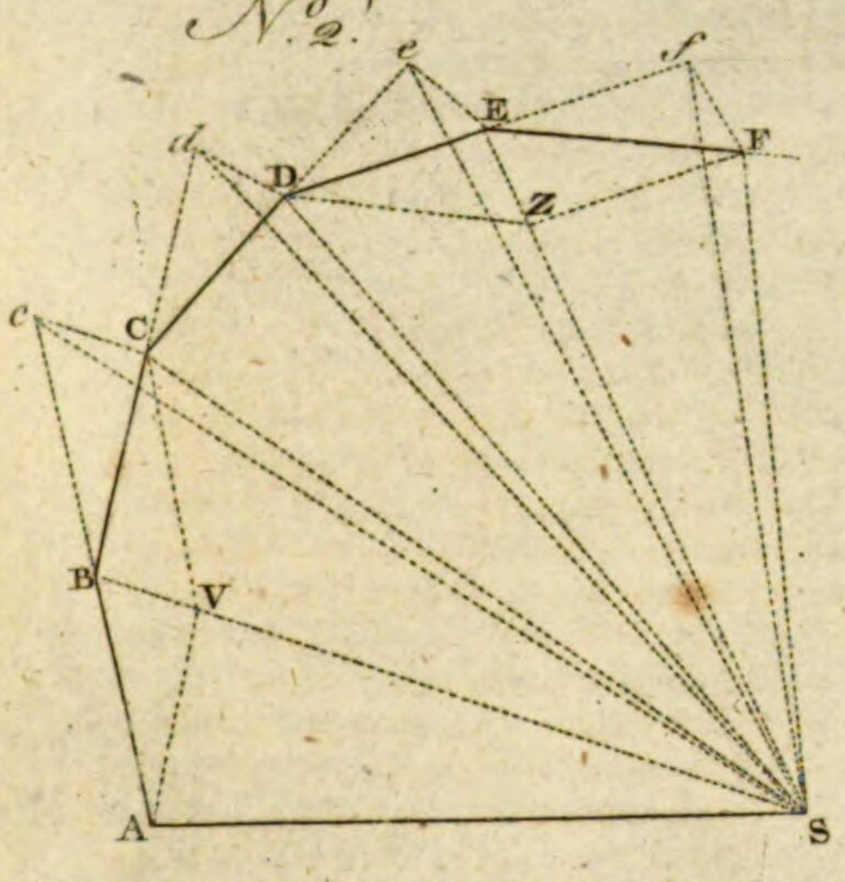


Dipping Needle. Fig. 2.



Newtonian philosophy.

N.o 2.



N.o 1.

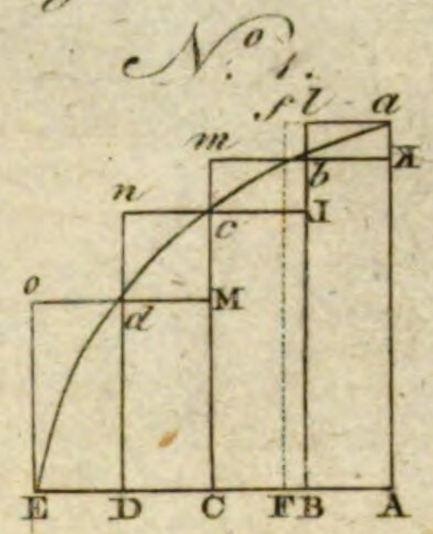
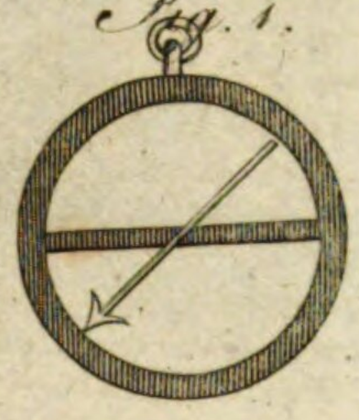


Fig. 1.



Nereis.

Fig. 1.

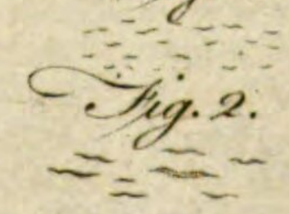


Fig. 2.

Fig. 3.

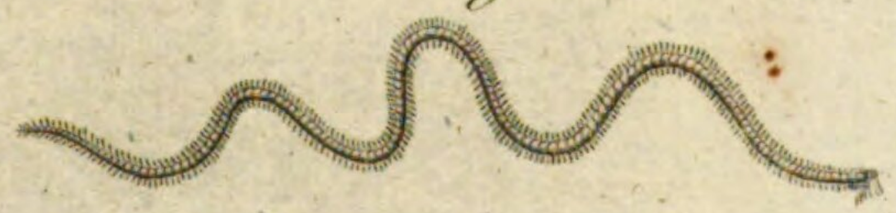


Fig. 4.

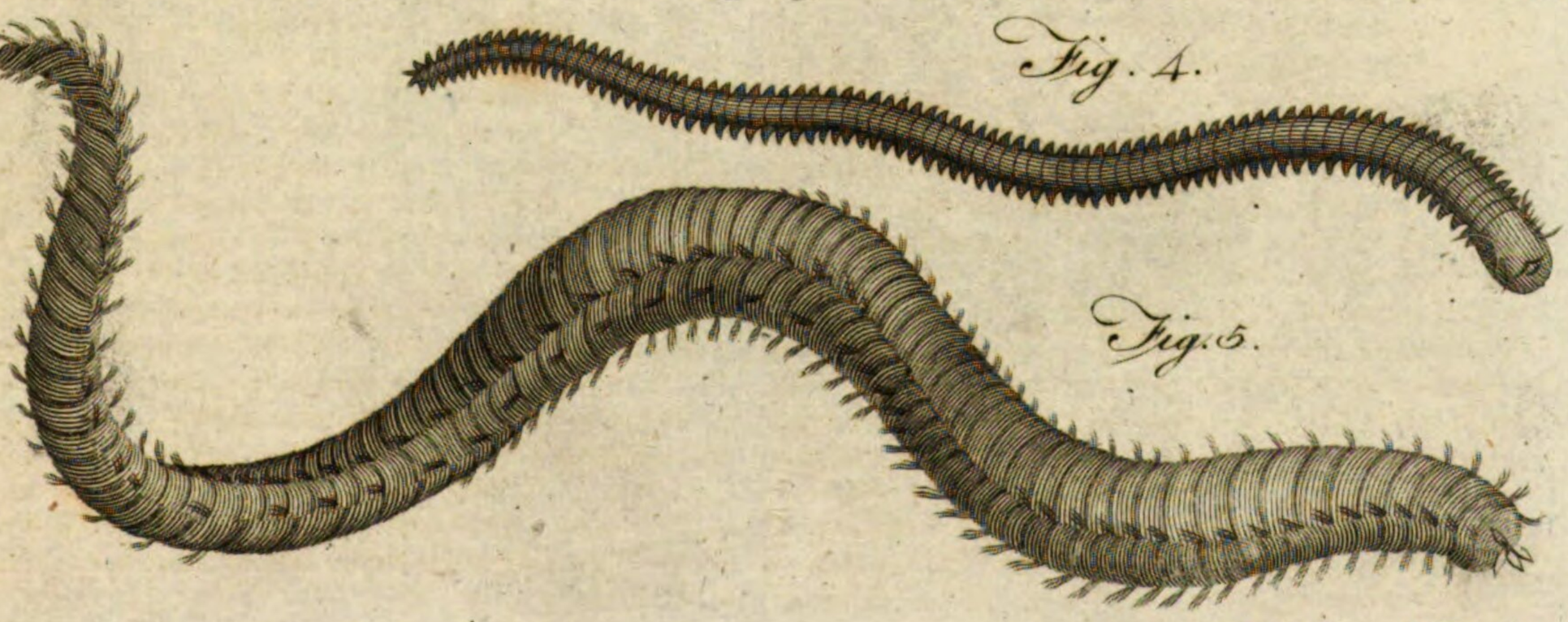


Fig. 5.

A. Bell Prin. Wal. Sculptor, fecit.

Needle || Nefaſti

needle ſhould be at leaſt a third part larger than thoſe generally uſed upon this occaſion, as great advantages will be found in the depreſſing of the cataract, by the increaſed breadth of the blade of that inſtrument. The handle, alſo, if made ſomewhat ſhorter than uſual, will enable the operator to perform with greater ſteadineſs, than he can do with a larger handled inſtrument.

It is to be obſerved, that needles of ſilver pierce more eaſily in ſtitching arteries after an amputation, than thoſe made of ſteel.

Needle-Fiſh. See Sygnathus.

Needles, ſharp-pointed rocks north of the Iſle of Wight. They are ſituated at the weſtern extremity of the iſland, which is an acute point of high land, from which they have been disjoined by the waſhing of the ſea. There were of theſe lofty white rocks formerly three, but about 14 years ago the talleſt of them, called *Lot's Wife*, which aroſe 120 feet above low-water mark, and in its ſhape reſembling a needle, being undermined by the conſtant efforts of the waves, overſet, and totally diſappeared.

NEEDS, or St Neots, ſix miles from Huntingdon, 58 miles from London, ſo called from the monument of a ſaint of that name in it, who was burnt by the Danes, is a large well-built town, having a handſome ſtrong church, with a prodigious fine ſteeple, and a good ſtone-bridge over the Ouſe, by which coals are brought to it, and ſold through the country. It has a charity-ſchool for 25 poor children. Its market is on Thurſday; fairs on Holy Thurſday, Aug. 1. Corpus-Chriſti Thurſday, June 13. and December 17.; and it is famous for a medicinal ſpring.

NEEDWOOD-forest, in Staffordſhire, between the Trent, Dove, and Blythe, and near Uttoxeter, is ſaid to exceed all the foreſts in England in the excellency of its ſoil and the fineneſs of its turf.

NE EXEAT REGNO, in law, is a writ to reſtrain a perſon from going out of the kingdom without the king's licence. F. N. B. 85. It may be directed to the ſheriff, to make the party find ſurety that he will not depart the realm, and on refuſal to commit him to priſon: or it may be directed to the party himſelf; and if he then goes, he may be fined. And this writ is granted on a ſuit being commenced againſt a man in the chancery, when the plaintiff fears the defendant will fly to ſome other country; and thereby avoid the juſtice and equity of the court; which hath been ſometimes practiſed: and when thus granted, the party muſt give bonds to the maſter of the rolls, in the penalty of 1000 l. or ſome other large ſum, for yielding obedience to it; or ſatisfy the court, by anſwer, affidavit, or otherwiſe, that he hath no deſign of leaving the kingdom, and give ſecurity.

NEFERN, in Pembrokeſhire, a village in whoſe church-yard is a remarkable old croſs. The church has no pavement in it, and the frequent burials have raiſed the ground within it to ſeven or eight feet higher than without. In proceſs of time, inſtead of a church, it will be only a ſepulchre. It is pleaſantly ſituated on the banks of a river of the ſame name near Newport.

NEFASTI dies, in Roman antiquity, an appellation given to thoſe days wherein it was not allowed to adminiſter juſtice, or hold courts. They were ſo called becauſe, *non fari licebat*, the prætor was not allowed to pronounce the three ſolemn words or formulas of the law, *do*, *dico*, *addico*, I give, I appoint, I adjudge. Theſe days were diſtinguiſhed in the calendar by the letter N. for *nefaſtus*; or N. P. *Nefaſtus Primo*, when the day was only *nefaſtus* in the forenoon, or firſt part. The days of a mixed kind were called *interciſi*.

Negapatan || Negative.

NEGAPATAN, a town of Aſia in the peninſula on this ſide the Ganges, and on the coaſt of Coromandel. It was firſt a colony of the Portugueſe, but was taken from them by the Dutch. The factory purchaſe very little beſides tobacco and long linen cloths; however, the Dutch have thought proper to erect a fort here. It is ſituated in E. Long. 79. 10. N. Lat. 11. 15.

NEGATION, in logic, an act of the mind affirming one thing to be different from another; as that the ſoul is not matter. See Logic.

NEGATIVE, in general, ſomething that implies a negation: thus we ſay, negative quantities, negative powers, negative ſigns, &c.

Negative-Sign. The uſe of the negative ſign, in algebra, is attended with ſeveral conſequences that at firſt ſight are admitted with difficulty, and has ſometimes given occaſion to notions that ſeem to have no real foundation. This ſign implies, that the real value of the quantity repreſented by the letter to which it is prefixed is to be ſubtracted; and it ſerves, with the poſitive ſign, to keep in view what elements or parts enter into the compoſition of quantities, and in what manner, whether as increments or decrements, (that is, whether by addition or ſubtraction), which is of the greateſt uſe in this art.

In conſequence of this, it ſerves to expreſs a quantity of an oppoſite quality to the poſitive, as a line in a contrary poſition; a motion with an oppoſite direction; or a centrifugal force in oppoſition to gravity; and thus often ſaves the trouble of diſtinguiſhing, and demonſtrating ſeparately, the various caſes of proportions, and preſerves their analogy in view. But as the proportions of lines depend on their magnitude only, without regard to their poſition, and motions and forces are ſaid to be equal, or unequal, in any given ratio, without regard to their directions; and, in general, the proportion of quantity relates to their magnitude only, without determining whether they are to be conſidered as increments or decrements; ſo there is no ground to imagine any other proportion of $-b$ and $+a$ (or of -1 and 1) than that of the real magnitudes of the quantities repreſented by b and a, whether theſe quantities are, in any particular caſe, to be added or ſubtracted. It is the ſame thing to ſubtract a decrement, as to add an equal increment, or to ſubtract $-b$ from $a-b$, as to add $+b$ to it: and becauſe multiplying a quantity by a negative number implies only a repeated ſubtraction of it, the multiplying $-b$ by $-n$, is ſubtracting $-b$ as often as there are units in n; and is therefore equivalent to adding $+b$ ſo many times, or the ſame as adding $+nb$. But if we infer from this, that 1 is to $-n$ as $-b$ to nb, according to the rule, that unit is to one of the factors as the other factor is to the product, there is no ground to imagine that there is any myſtery in this, or any other meaning than that the real magnitudes repreſented by 1, n, b, and nb are proportional. For that rule relates only to the mag-

Negative ‖ Negro.

nitude of the factors and product, without determining whether any factor, or the product, is to be added or subtracted. But this likewise must be determined in algebraic computations; and this is the proper use of the rules concerning the signs, without which the operation could not proceed. Because a quantity to be subtracted is never produced in compoſition by any repeated addition of a poſitive, or repeated ſubtraction of a negative, a negative ſquare number is never produced by compoſition from the root. Hence $\sqrt{-1}$, or the ſquare root of a negative, implies an imaginery quantity; and, in reſolution, is a mark or character of the impoſſible caſes of a problem, unleſs it is compenſated by another imaginary ſymbol or ſuppoſition, when the whole expreſſion may have a real ſignification. Thus $1+\sqrt{-1}$, and $1-\sqrt{-1}$ taken ſeparately, are imaginary, but their ſum is 2; as the conditions that ſeparately would render the ſolution of a problem impoſſible, in ſome caſes deſtroy each others effect when conjoined. In the purſuit of general concluſions, and of ſimple forms repreſenting them, expreſſions of this kind muſt ſometimes ariſe where the imaginary ſymbol is compenſated in a manner that is not always ſo obvious.

By proper ſubſtitutions, however, the expreſſion may be transformed into another, wherein each particular term may have a real ſignification as well as the whole expreſſion. The theorems that are ſometimes briefly diſcovered by the uſe of this ſymbol, may be demonſtrated without it by the inverſe operation, or ſome other way; and though ſuch ſymbols are of ſome uſe in the computations by the method of fluxions, its evidence cannot be ſaid to depend upon arts of this kind. See Maclaurin's Fluxions, book ii. chap. 1. and Ludlam's Algebra, *paſſim*.

Negative Electricity. See the article *Electricity*, *paſſim*. See alſo *Positive Electricity*.

NEGINOTH. This term is read before ſome of the Pſalms, as Pſalm lxvii. It ſignifies *ſtring inſtruments of muſic*, to be played on by the fingers, or women muſicians; and the titles of thoſe pſalms where this word is found, may be thus tranſlated, *A pſalm of David to the maſter of muſic, who preſides over the ſtring-inſtruments*.

NEGOMBO, a ſea-port town of Aſia, on the weſt coaſt of Ceylon. It has a fort built by the Portugueſe, which was taken from them by the Dutch in 1640. E. Long. 80. 25. N. Lat. 17. 0.

NEGRIL POINT, the moſt weſterly promontory of the iſland of Jamaica.

NEGRO, *Homo pelli nigra*, a name given to a variety of the human ſpecies, who are entirely black, and are found in the Torrid zone, eſpecially in that part of Africa which lies within the tropics. In the complexion of negroes we meet with many various ſhades; but they likewiſe differ far from other men in all the features of their face. Round cheeks, high cheek-bones, a forehead ſomewhat elevated, a ſhort, broad, flat noſe, thick lips, ſmall ears, uglineſs, and irregularity of ſhape, characterize their external appearance. The negro women have the loins greatly depreſſed, and very large buttocks, which gives the back the ſhape of a ſaddle. Vices the moſt notorious ſeem to be the portion of this unhappy race: idleneſs, treachery, revenge, cruelty, impudence, ſtealing, lying, profanity, debauchery, naſtineſs, and intemperance, are ſaid to have extinguiſhed the principles of natural law, and to have ſilenced the reproofs of conſcience. They are ſtrangers to every ſentiment of compaſſion, and are an awful example of the corruption of man when left to himſelf. Negro.

The origin of the negroes, and the cauſe of thier remarkable difference from the reſt of the human ſpecies, has much perplexed the naturaliſts. Mr Boyle has obſerved, that it cannot be produced by the heat of the climate: for though the heat of the ſun may darken the colour of the ſkin, yet experience does not ſhow that it is ſufficient to produce a new blackneſs like that of the negroes.

In Africa itſelf, many nations of Ethiopia are not black; nor were there any blacks originaly in the Weſt Indies. In many parts of Aſia, under the ſame parallel with the African region inhabited by the blacks, the people are but tawny. He adds, that there are negroes in Africa beyond the ſouthern tropic; and that a river ſometimes parts nations, one of which is black, and the other only tawny. Dr Barriere alleges, that the gall of Negroes is black, and being mixed with their blood is depoſited between the ſkin and ſcarf-ſkin. However, Dr Mitchel of Virginia, in the Philoſophical Tranſactions n° 476. has endeavoured by many learned arguments to prove, that the influence of the ſun in hot countries, and the manner of life of their inhabitants, are the remote cauſes of the colour of the Negroes, Indians, &c. Lord Kaimes, on the other hand and ſuch philoſophers as he, whoſe genius and imagination are too lively to ſubmit to a dry and painful inveſtigation of facts, have contended, that no phyſical cauſe is ſufficient to change the colour, and what we call the regular features of white men, to the dark hue and deformity of the woolly-headed negro. Their arguments have been examined with much acuteneſs and ingenuity by Dr Stanhope Smith of New Jerſey, Dr Hunter, and profeſſor Zimmerman, who have made it in a high degree probable, that the action of the ſun is the original and chief cauſe of the black colour, as well as diſtorted features, of the negro. See America, n° 48—51. and Complexion.

True negroes are found in no quarter of the globe where the heat of the climate is not very great. They exiſt no where but in the Torrid zone, and only in three regions ſituated in that zone, to wit, in Senegal, in Guinea, and on the weſtern ſhores of Africa, in Nubia, and the Papous land, or what is called *New Guinea*. In all theſe regions the atmoſphere is ſcorching, and the heat exceſſive. The inhabitants of the north are whiteſt; and as we advance ſouthwards towards the line, and thoſe countries on which the ſun's rays fall more perpendicularly, the complexion gradually aſſumes a darker ſhade. And the ſame men, whoſe colour has been rendered black by the powerful action of the ſun, if they remove to the north, gradually become whiter (at leaſt their poſterity), and loſe their burnt colour. Whites, when tranſported into the burning regions of the Torrid zone, are at firſt ſubject to fever; the ſkin of the face, hands, and feet, becomes burnt, hardens, and falls off in ſcales. Hitherto the colour of negroes appears to be only local, extrinſic, and accidental, and their ſhort frizzled

Negro. frizzled hair reſembles fine wool. May we not alſo ſuppoſe, that the varieties in the colour of negroes, who are always naked, are owing to the different temperature of their climates? During eight months of the year they have a continued drought, a ſky conſtantly clear, no rain or ſtorm of any kind, exceſſive heat, and a plentiful fall of dew after ſun-ſet. Their food and the exhalations from the ſurface of the earth may likewiſe contribute to the production of this phenomenon. In a European or white, the lymph is white, except when it is mixed with bile, which gives a yellow tint to the ſkin. But in a negro, whoſe lymph and bile are black, according to ſome accounts, the ſkin ought in like manner to be of the ſame colour. It is maintained, however, by ſkilful anatomiſts, that the blood, lymph, chyle, and other fluids, even the eyes, teeth, bones, internal part of the lips, &c. of negroes, are not of a different colour from ours. It is evident, then, that the races of black and white men are not two different ſpecies, becauſe the fruit of their connection has the faculty of reproducing beings like themſelves, excepting the colour.

The young negroes at birth, and even negro fœtuſes, have a conſiderable reſemblance to whites, excepting only that the ſcrotum and glans penis are black, and that they have a black or brown thread or circle on the extremity of the nails. Theſe marks are a certain ſign that the infant will be black; and negro fathers, who ſuſpect the fidelity of their wives, conſider the want of them as a ſufficient reaſon for abandoning the offspring. Among the Indians, the ſcrotum is grey, and in mulattoes of a pale red. The bodies of young negroes are whitiſh for the firſt eight days, but their natural colour, though weak, is eaſily diſcernible: the ſkin begins to grow brown, then aſſumes a colour inclining to that of biſtre, and laſt of all becomes black.

Some modern anatomiſts of great celebrity, who have inquired into the cauſe of this blackneſs, have found, that the reticulum in negroes is really as black as ink, and that this mucous colour ſhines through the whitiſh epidermis, which is thin and tranſparent. See *Mem. de l'Acad. des Sciences*, part 30. art. 13. *anno* 1702. See alſo *Traité de la couleur de la peau humaine*, by M. le Cat; who ſays, that we muſt ſeek, in the nervous ſyſtem, and the parts connected with it, for the fabrication of thoſe colours which give a taint to the ſkin of animals, and particularly of the animal Ethiops, which produces the colour of the negro.—It has been added, that the medullary ſubſtance of the brain in negroes is generally bluiſh; and that from this principle it follows, that the colour of the ſkin in the inhabitants of different zones depends upon the mucous ſubſtance of the reticulum. We have, however, been aſſured by phyſicians who had the beſt of opportunities of making obſervations, that the pretended facts upon which this hypotheſis is built are mere imaginations, and that there is no apparent difference between the medullary ſubſtance of the brain in negroes and the medullary ſubſtance of other men.

A number of other facts equally remarkable are mentioned by authors concerning different men who have been born white in Europe, and who have become black in the ſame climate. In our days a metamorphoſis of this kind, from white to black, or from black to white, is ſaid to be renewed every year in the perſon of a very reſpectable and amiable lady of diſtinction in France, who has a fair complexion and a very white ſkin. Upon her becoming pregnant, ſhe begins to grow brown, and towards the end of her pregnancy, her colour is that of a true negro. After delivery the black colour gradually diſappears, her former whiteneſs returns; and her offspring has not the ſmalleſt taint of black. This has been given to us as a certain fact; but we will not vouch for its truth. We have indeed ſeen women grow darker in their conplexion during their pregnancy, and recover their fairneſs after delivery; and we ſuſpect that a greater change of this kind than we have ſeen, has been exaggerated to the metamorphoſis juſt mentioned. We have heard likewiſe of negroes born in Guinea, who, even in the climate of Africa, have in the ſame manner become white, without ever returning to their former colour. Not long ago we had an account from Surinam of a negro of Angola whoſe ſkin and hair were perfectly white, though both his father and mother had very dark complexions. The eyes of this *albino*, or white negro, had a conſtant vibratory motion, and were incapable of diſtinguiſhing objects with exactneſs except in the dark. In the *Journal de Phyſique* of M. Roſier for May 1777, M. Dicquemare has publiſhed an account of a white negro girl who was born at Dominica in 1759 of black parents. She has all the features of the negroes, eſpecially thoſe of Lower Guinea; and her hair, eye-brows, and eye-laſhes, are the ſame in every reſpect, except the colour. Her hair, though a kind of very ſhort wool, is fair; and her eye-brows as well as eye-laſhes are of a yellowiſh pale colour. The colour of her ſkin is a dead white; her cheeks, lips, noſe, and other ſanguine parts, have a ſlight teint of red, which becomes ſtronger when ſhe is affected with livelineſs or fear. Her eyes are long; the pupils approach, or ſometimes recede from, each other, with a continual and involuntary motion; ſhe is weak but not ſhort-ſighted. Light is diſagreeable to her, and towards night ſhe ſees neither better nor farther than others. She has a timid air, a ſoft voice, and the ſmell of green leeks; but her ſkin is not ſoft like that of the negroes. Her parents have had ſeveral black children; but it is ſaid, that an older one, who was born white, gradually became blacker as he grew up, and at laſt aſſumed the colour of the *cabres*. We have ourſelves ſeen a white negro girl in London; and during the years of 1778 and 1779 there was one in Paris, whoſe miſtreſs tried, but without ſucceſs, to get her a place among the rare animals in the Menagery at Chantilly. See Albino.

The following is a table of the mixtures which produce a degradation of the black and white colours in the human ſpecies.

1. A white man with a negro woman, or a negro man with a white woman, produce a mulatto, half white and half black, or of a yellow-blackiſh colour, with black, ſhort, frizzled hair.

2. A white man with a mulatto woman, or a negro with a mulatto woman, produce a *quarteron*, three fourths white and one fourth black, or three fourths black and one fourth white, or of a lighter yellow than the former. In America, they give the name

Negro. of *cabres* to thoſe who are deſcended from a black man and a mulatto woman, or a mulatto man and a black woman, who are three fourths black and one fourth white, and who are not ſo black as a negro, but blacker than a mulatto.

3. A white man with a quarteron woman, or a negro with a quarteron woman, produce a *meſtizo*, ſeven eighths white and one eighth black, or ſeven eighths black and one eighth white.

4. A white man with a meſtizo woman, or a negro with a meſtizo woman, produce, the one almoſt a perfect white, the other almoſt a perfect black. In following generations, if a conſtant intermixture has taken place, and the white has been married in Europe, the black in Senegal, the complexion will gradually become fairer or darker, till the offspring is either entirely black or entirely white.

Such is the progreſs of phyſical effects and cauſes in the degradation of the colour of the human ſpecies. Croſſing the breed for four generations is ſufficient to render a negro white, and the ſame will make a white black. It is evident that the mixtures, a mulatto man with a quarteron or meſtizo woman, will produce other colours approaching to white or black, in proportion to the progreſſion above ſtated.

We have already obſerved, under former articles, that the preſervation and continuation of the particular ſpecies appears to proceed from that parent, who, in the act of procreation, has diſcovered moſt ſtrength and vigour; and this is commonly the father. A young negro woman in Virginia, after having brought forth for the firſt time a black child, was delivered a ſecond time of twins; one of them, a boy, was black, and the other, who was a girl, was a mulatto. As the boy grew up, he retained his ſhort hair, which was naturally frizzled, and had a reſemblance to wool; other marks plainly ſhowed that he was a true negro, and in every reſpect like the black father who had begotten him. The girl, on the other hand, was tolerably white; ſhe had blue eyes, long black hair, without any natural curl; in ſhort, ſhe had a great reſemblance to the overſeer of the plantation, whom the negro huſband ſuſpected of cohabiting with his wife. Becoming pregnant a third time, ſhe was delivered of three children, two of them mulattoes, and the other a perfect negro. Shall we aſcribe this to the effect of imagination? Such an explanation is rejected by the philoſopher as abſurd, and contrary to every law of nature. We can account for the third delivery, therefore, only by admitting the cohabitation of two fathers of different races, and then a ſuperfœtation.

Thus we ſee that the white or black colour is only an accidental variety in warm climates, which is confirmed or effaced in foreign climates. In the ſame manner, the black colour, which in moſt climates is natural to ſeveral kinds of brute animals, is altered or entirely effaced in a different zone. Thus the blackbird, the raven, and the bear, which with us are black, are grey or white in the north. The union of the ſame ſpecies in the ſame climates makes theſe varieties hereditary. We repeat it; the black colour in the torrid zone proceeds from a cauſe altogether extrinſic, depends ſolely on local temperature, and in the human ſpecies is as accidental as the brown, the red, the yellow, the olive, and the tawny colour. We muſt conſider the whites as the ſtock whence all others have ſprung. Adam and Eve and their poſterity, till the time of the deluge, were white; in the firſt age of the world no black nation was to be found on the face of the earth; the regions of the torrid zone were then unknown. Let us conſult the ſacred and profane hiſtorians, and we ſhall find that Noah, his three ſons, and their wives, who were ſaved in the ark, divided among themſelves the whole old continent, in which Africa was then included. The diſperſion of Noah's deſcendants did not take place till after the confuſion of tongues at Babel. Thoſe who paſſed into Africa, multiplied there, and their poſterity penetrated by degrees to the extremity of the peninſula. The original inhabitants of Africa were at firſt white; but by living there they afterwards became ſomewhat tawny: their children were of a darker hue and almoſt mulattoes; in the progreſs of time other ſucceeding generations became complete Moors; thoſe who ſpread towards the tropics ſoon became half blacks; and thoſe who lived under the equator, or in the Torrid zone, from the influence of the ſun and climate, appeared in the courſe of a few generations perfectly black. A very conſiderable ſpace of time muſt neceſſarily have elapſed before this gradual and imperceptible change could be produced. The Iſhmaelites, Saracens, Moors, and Arabs, who invaded the weſtern part of Africa, likewiſe became black in a few generations; while thoſe of the ſame nations who invaded Spain, underwent little or no change of colour; which was whitiſh in ſome, and tawny or yellow in others. M. de Manet, who has lately publiſhed an excellent hiſtory of Africa, conjectures that the complete change from white to perfect black might have been at the end of three centuries; this makes 15 generations, allowing 20 years for each generation. Benjamin de Tudelle, the celebrated Jewiſh traveller, ſaid, in 1175, that the white colour became perfectly black in no more than ſix centuries, and in the courſe of 30 generations without croſſing the breed. A greater number of generations is undoubtedly neceſſary before negroes, when tranſplanted into our temperate countries, can entirely loſe their black colour. Negro.

If we examine philoſophically, and with attention, two negroes, the one of the ancient and the other of the modern race, we ſhall obſerve that thoſe parts of the ſkin which are not expoſed to the ſun's rays, or but in a ſmall degree, loſe their colour, or at leaſt retain but a ſlight taint of it, ſuch as the arm-pits, the ſpaces between the fingers, the inſide of the hands, the ſpace under the chin, the ſoles of the feet, the ſpace between the thighs, and the lower part of the belly; whereas the head, the outſide of the arms, the back, the belly, and the ſhoulders, being continually expoſed to the air (for their ſkin is their only covering), are of a blacker colour. The women who are employed in waſhing, and whoſe hands are conſequently often in the water, have theſe parts almoſt white. In thoſe who have received wounds, who have ſuffered by burnings, or who retain marks of the ſmall-pox, the parts which were affected are of a tawny colour.

Negroes are brought from Guinea and other coaſts of Africa, and ſent to America and the colonies in the

Negro. West Indies, to cultivate tobacco, ſugar, indigo, &c. and in Mexico and Peru to dig in the mines; and this commerce is now carried on by all the nations of Europe that have ſettlements in the Weſt Indies. Mahometan nations, too, import negroes from the pagan parts of Africa, for the purpoſe of making them eunuchs, and guards of their harems. The beſt ſlaves for Weſt India purpoſes are the negroes who are brought from Angola, Senegal, Cape Verd, the river Gambia, the kingdoms of the Jaloffes, &c. (See Guinea.) This traffic is perhaps ſhocking, but it need not appear ſtrange.

Through the whole of the peninſula of Africa with which we are acquainted, ſlavery has been prevalent from time immemorial. In the interior parts, one claſs of the people are born ſlaves to another; and on the gold coaſt, a freeeman is reduced to that ſtate for crimes real or imaginary. Priſoners of war are all conſidered as ſlaves, and, together with criminals, are ſold, either by one negro chief to another, or by ſlave-brokers, to European merchants. Slaves which are born ſuch are not permitted to be ſold out of the country, unleſs they have been guilty of ſome offence which would have ſubjected them either to that ſtate or to death, though they had been born freemen.

The crimes for which freemen are made ſlaves, are theft, debt, adultery, and witchcraft; and it is not uncommon for perſons to game themſelves away. All ſavages have an itch for games of hazard; and a negro will ſtake his freedom on a throw of the dice. If he loſe, no trial is neceſſary; he immediately ſurrenders himſelf to his ſucceſsful antagoniſt. Perſons accuſed of crimes are tried by certain judges called *Pynim's*, who wear a peculiar ſtraw-hat as a badge of their office; and the trial is fairly conducted, according to the laws of the country, either in the market-place or in an open court of juſtice. Witchcraft proved againſt a man involves in his puniſhment the whole family, which is always extirpated, if there be not a European merchant to buy them; and adultery committed with the wife of a great man is conſidered as a crime of too deep a dye to be puniſhed with ſlavery either to a black or a white maſter. Such offenders are inſtantly doomed to death.

Human ſacrifices have at all times been practiſed in Africa; and ſuch is the depravity of the negro princes, that there is reaſon to believe that priſoners of war are either all ſacrificed or ſold to foreign merchants. That inſolvent debtors ſhould be reduced to ſlavery, among a people ſo very barbarous, can excite no wonder, when we conſider that the ſame thing took place among the Romans, in the earlier periods of the commonwealth. (See Nexi.) It likewiſe took place among the Jews, and all other ancient nations; and it is apparent from the poems of Homer, that the early Greeks treated their captives, whether male or female, as part of their property. Of the ſlaves imported into the Britiſh colonies, great part are brought from a great diſtance to the coaſt; and as theſe exhibit little or no ſymptoms of uneaſineſs at their being ſold into a foreign country, and doomed to ſerve maſters whom they never ſaw before, the probability is, that they have been born ſlaves to tyrants ſo cruel, that no change of maſters can, in their apprehenſion, increaſe their wretchedneſs. Negroes born on the coaſt are often extremely miſerable on the thoughts of being ſold to a foreign maſter; becauſe theſe men were originally free, and expect ſuch treatment as they have ſeen their own chiefs inflict upon priſoners of war, or perſons who, among them, have been reduced from freedom to a ſtate of ſlavery. Negro.

Theſe facts are mentioned, not with a view to defend or condemn the Britiſh ſlave-trade, which will be conſidered in another place, (See Slavery and Slave-Trade); but merely becauſe they account for that ferocity and brutality by which negroes in many reſpects reſemble the moſt ſavage beaſts of prey. Some of them have been known to feed on their brothers, and to devour their own children. But what indeed can be expected of men in their unhappy ſituation? Almoſt all blacks, but eſpecially thoſe of Loanga, treat their women as vile ſlaves, created ſolely to amuſe and obey them. The wife often dares not look at her lord; ſhe ſpeaks to him on her knees; and yet this painful and humiliating ſituation is not diſtreſſing to them. Some negroes, however, are ſufficiently attached to their wives, and exceedingly fond of their miſtreſſes: theſe yield in no reſpect to the men, but obey without reſerve the natural impulſe of their conſtitution. We likewiſe find negroes of Congo, who, in order to pleaſe, become great jeſters and buffoons. A ſingle Congo ſlave is ſufficient to diffuſe chearfulneſs and good humour through a whole plantation. But how comes it about that female negroes, who are ſo prolific in Africa, are not equally ſo in America?

To diſcover the cauſe of ſuch ſterility, is an object worthy of the attention of government. According to ſome, theſe ſlaves are often inſtigated by the bitterneſs of their lot to rid themſelves of a burden which other mothers ſupport with pleaſure. This, however, cannot be the fact. Without in any degree pleading the cauſe of the Weſt India planters, we may venture to ſuppoſe, that, in this caſe, intereſt will ſupply the place of that principle of humanity which their opponents affirm them to want. To rear a negro is leſs expenſive than to purchaſe one from Africa; and by the confeſſion of all parties, a creole ſlave is double the value of one juſt imported. That ſelfiſhneſs, therefore, of which the ſugar-planters have been ſo often and ſo vehemently accuſed, would make them, one ſhould think, encourage, by every mean in their power, the propagation of negroes, ſince by the laws of the colonies the child of a female ſlave is the property of her maſter. We doubt not that in the Weſt Indies, as every where elſe, there are men who in ſudden burſts of paſſion forget their intereſt as well as their duty; and we are not inclined to deny, that there may be many inſtances of cruelty practiſed on the ſlaves both male and female; but in Africa, cruelty is reduced to a ſyſtem, and yet the mothers nurſe and rear their children.

One cauſe certainly of the barrenneſs of colonial negroes, is the ſmall number of females in proportion to the males, and the diſſolute and licentious lives which they lead. It is a fact, for which phyſiologiſts muſt account, that when a woman, whether white or black, has a promiſcuous intercourſe with a number of men, ſhe very ſeldom conceives children; and as our negroes in the Weſt Indies are inſtructed in no principles of religion, and have appetites as keen as their

Negro, Negroland

their maſters and their miſtreſſes, it is not ſurpriſing that many of the females abandon themſelves to licentious amours, and become in conſequence incapable of conception. The popiſh clergy in the French and Spaniſh iſlands, and the Moravian and Methodiſt paſtors in our own, are at the utmoſt pains to inſtruct the negroes in what they conceive to be the truths of Chriſtianity; whilſt the miſſionaries of the Engliſh church too generally neglect every duty of their ſacred function. The biſhop of London has been expected, as dioceſan of the Weſt Indies, to take upon himſelf the forming of ſome plan for the religious inſtruction of the negroes in the colonies ſuited to their temporal condition; but in juſtice to that prelate, as well as to the memory of his immediate predeceſſors, it is proper to acquaint the public, that ſince the death of Dr Gibſon in 1748, the biſhop of London has had no eccleſiaſtical authority whatever in the colonies, nor any other epiſcopal connection with them, than that of conferring orders upon their candidates for livings. That the colonies would gladly adopt any proper plan for improving the morals and meliorating the condition of the negroes, has been lately proved by the moſt reſpectable evidence given at the bar of the houſe of lords; and were ſuch a plan put in execution, there cannot be a doubt, but that the ſlaves would be more diligent and faithful, the maſters have leſs occaſion to exerciſe cruelty, and the females, if imported in a ſufficient number, be as prolific as other women in the ſame latitudes.

Both in France and in England laws have been lately enacted, to preſerve the lives of negroes on what is called the *middle paſſage*, and to regulate the adminiſtration of juſtice to the negro-ſlaves in the Weſt Indies. An edict to this purpoſe was, ſo far back as March 1724, publiſhed at Verſailles, called the *black code*; and laws have been lately made by the parliament of Great Britain, to inſure better accommodation to the negroes on board of ſhip from Africa to the ſugar iſlands. The colonial aſſemblies have likewiſe themſelves enacted laws to protect the perſons of the negroes while in their ſtate of ſervitude; and in ſome eſtates, theſe laws have been ſo well obſerved, that we have been informed by gentlemen of undoubted veracity, that they have known negro-ſlaves poſſeſſed of one, two, and 3000 l. So horrible, however, to a Britiſh ear is the very ſound of the word ſlavery, that a ſociety was ſome years ago inſtituted at London, for the purpoſe of procuring an abolition of the ſlave-trade; and petitions to parliament for the ſame purpoſe were obtained from almoſt every county and town in the kingdom. The ſucceſs of theſe petitions, as well as their conſequences, will ſoon be known, when we ſhall take an opportunity of laying them before our readers.

NEGROLAND, or Nigritia, a country of Africa, lying next to Guinea towards the north, and extending from 18° of weſt to 150' of eaſt longitude, and from 10° to 20° of north latitude. On the north it is bounded by Zara or the Deſart; on the eaſt, by countries unknown; on the ſouth, by Guinea; and on the weſt, by the Atlantic Ocean; and is watered by the great river Niger or Senegal, which runs through it from eaſt to weſt. The Europeans have ſettlements on the coaſts of this country, eſpecially near the mouths of the Niger and Gambia, which laſt is ſuppoſed to be a branch of the former. A great many nations inhabit the banks of the rivers; ſome Pagans, ſome Mohammedans, of different languages, and independent of one another. The country is fruitful, eſpecially along the rivers; abounding in rice, Guinea grain, and Indian corn, where it is cultivated; and with cocoa-nuts, plantains, pulſe, palm-trees, and tropical fruits; nor is it deſtitute of cattle, and a variety of other animals, particularly ſuch as abound in Guinea. See Guinea. Negroland,

Negroland is fertilized by the overflowing of its rivers the Senegal and Gambia, as Egypt is by the Nile. It hath not yet been aſcertained whether the Gambia is a branch of the Senegal or not. As far as the Europeans have penetrated up the country, they appear to be diſtinct; and the Mundingo Negroes report that the Gambia has a different origin. The entrance into the Niger or Senegal river is narrow and ſomewhat difficult, by reaſon of its immoveable bar and ſandy ſhoals, as well as the ſeveral iſlands at the mouth of it, and the ſeveral canals and marſhes that clog it: but after ſailing up eight or ten leagues, it is found broad and deep, and fit to carry large veſſels; and, excepting about five or ſix leagues on each ſide above the mouth, which is ſandy and barren ground, the banks are covered with ſtately trees and villages, and the country in general is fertile and well watered; for, like the Nile, this river overflows its banks for many leagues, and enriches the land to a great degree, though, for want of ſkill, the inhabitants do not reap the advantages which they might obtain from its fertility. The people on both ſides of the river live as near to it as they can, and feed great herds of cattle, ſowing large and ſmall millet, the former of which is called by us *Turkey wheat*, in great quantities, and with great increaſe. If the river fails of overflowing at its uſual ſeaſon, a great ſcarcity enſues in the adjacent country; and, even when it overflows regularly, it breeds ſuch vaſt flights of graſshoppers and inſects, as quite darken the air, and frequently devour all the product of the earth: in which caſe the people kill thoſe inſects and eat them; which they do either by pounding in leathern bags, and then boiling them in milk, or, which is reckoned the more delicious method, by frying or broiling them over a light blaze, in a frying-pan full of holes. Thus the legs and wings of the inſects are burnt off, and the reſt of the body is ſufficiently roaſted to be eaten as a dainty, which they look upon to be very wholeſome and nouriſhing.

To the eaſt, north-eaſt, and ſouth-eaſt of the iſland of Senegal, the country, as far as it is known, is over-run with woods and marſhes; the Senegal, Gambia, and Sherbro, which are looked upon by ſome as branches of one immenſe river, paſſing through it in their way to the Atlantic Ocean. During the rainy months, which begin in July, and continue to October, they lay the whole country under water; and indeed the ſudden riſe of theſe rivers is incredible to ſuch as are not acquainted with the violent rains that fall between the tropics. At Galam, 900 miles from the mouth of the Senegal, the waters riſe 150 feet perpendicular from the bed of the river. At the iſland of Senegal, the river riſes gradually, during the rainy ſeaſon,

Negroes, Negropont.

ſeaſon, above 20 feet perpendicular over part of that flat coaſt; which of itſelf ſo freſhens the water, that ſhips lying at anchor, at the diſtance of three leagues from its mouth, generally make uſe of it, and fill their water there for their voyage home. When the rains are at an end, which ſoon happens in October, the intenſe heat of the ſun uſually dries up thoſe ſtagnating waters which lie on the higher parts, and the remainder from lakes and marſhes, in which are found all ſorts of dead animals. At laſt, thoſe too are quite dried up; and then the effluvia that ariſe are almoſt quite inſupportable. At this ſeaſon the winds blow ſo hot from the land, that they may be compared to the heat proceeding from the mouth of an oven, and they bring with them an intolerable ſmell. The wolves, tigers, lions, and other wild beaſts, then reſort to the river, ſteeping their body under water, and only their ſnout above it for the ſake of breathing. The birds ſoar to an immenſe height in the air, and fly a vaſt way over the ſea, where they continue till the wind changes, and comes from the weſt.

Negroes White. See Heliophobi and Albino.

NEGROMANCY. See Necromancy.

NEGROPONT, anciently *Eubœa*, an iſland of the Archipelago, ſtretching along the eaſtern coaſt of Achaia or Livadia, from which it is ſeparated by a narrow channel called the *Euripus*. This ſtrait is ſo narrow, that the iſland is joined to the continent by a bridge thrown over it; and here, it is thought, there was formerly an iſthmus. The irregularity of the tides in the Euripus hath from the remoteſt antiquity been very remarkable, and this irregularity is found to be connected with the age of the moon. From the three laſt days of the old moon to the eighth day of the new moon, and from the 14th to the 20th day incluſive, they are regular; but on the other days they are irregular, flowing 12, 13, or 14 times in the ſpace of 24 hours, and ebbing as often. The iſland is 90 miles long and 25 broad in the wideſt part; and produces corn, oil, fruit, and cattle, in great abundance. The only place in the iſland worth notice is the capital, which is alſo called *Negropont*; and which is walled, and contains about 15,000 inhabitants; but the Chriſtians are ſaid to be much more numerous than the Turks. The captain baſhaw, or admiral of Turkey, who is alſo governor of the city, the iſland, and the adjacent continent of Greece, reſides here; and the harbour, which is very ſafe and ſpacious, is ſeldom without a fleet of galleys, ready to be put to ſea againſt the pirates and the Malteſe. A part of the bridge between the city and the coaſt of Greece, conſiſts of a drawbridge no longer than juſt to let a galley paſs through. Negropont.

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